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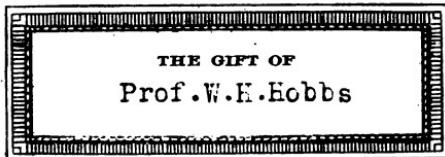
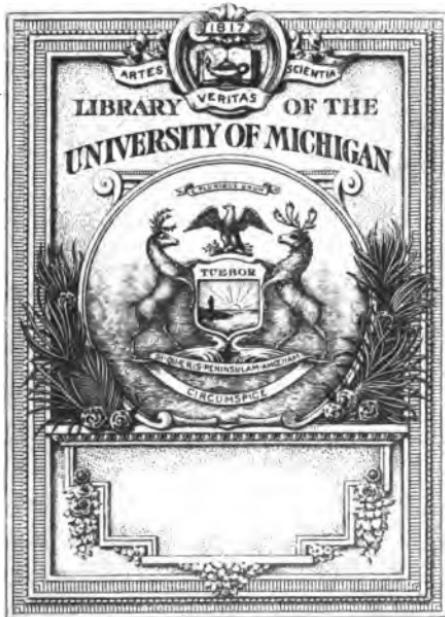
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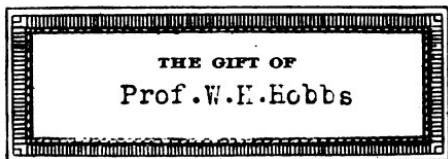
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PREFACE.

THE following pages are the work of a number of volunteers, students of science, history, and archaeology, and others conversant with the industrial progress of the district described. The illustrations are derived from a number of sources; and special thanks are due to those persons and institutions that have sanctioned the use of copyright material. Mr. T. J. Westropp has given great help in bringing together the illustrations in the section of History and Archaeology, for which Mr. W. Lawrence kindly gave some original blocks. The geological details on the coloured map were supplied by the Geological Survey of Ireland. The names of the editors of the sections, and of the contributors of the several articles contained in each, are given in the table of contents which follows, or in the body of the work. The general editing of the Handbook has been done by Grenville A. J. Cole and R. Lloyd Praeger.

DUBLIN, *August*, 1908.

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GEOLOGY.

GENERAL GEOLOGY AND SCENERY.

BY GRENVILLE A. J. COLE, M.R.I.A., F.G.S.

THE geology of the neighbourhood of Dublin has been several times described; and on the present occasion it seems desirable to furnish a general account, from which the visitor, though he may not be primarily a geologist, may gain some insight into the relations between the surface-features and the underlying structure of the country.

MAPS AND WORKS OF REFERENCE.

Dr. John Rutty, in his "Essay towards a Natural History of the County of Dublin" (2 vols., 1772), discussed the minerals and rocks from the point of view of their economic importance. R. Fraser published several geological observations on the Leinster chain and the drift gravels in his "General view of the agriculture and mineralogy, &c., of the County Wicklow" (Dublin, 1801). W. Fitton described "the geological structure in the vicinity of Dublin" in the first volume of the Transactions of the Geological Society of London, 1811, and reproduced the substance of his paper in 1812 in the form of a small book, entitled "Notes on the Mineralogy of part of the vicinity of Dublin." This is really a geological rather than a mineralogical essay, and includes notes from the papers of the Rev. Walter Stephens, of Dublin, and a coloured petrological map. In 1819, Weaver's "Memoir on the geological relations of the east of Ireland" was published

in the Transactions of the Geological Society of London; and its illustrations enabled readers to realize both the scenery and the structure of the Leinster chain. The Royal Dublin Society issued in 1835 a "Memorandum of objects of geological interest in the vicinity of Dublin," preparatory to the meeting of the British Association in that year. This is a pamphlet of 26 pages; but the progress of geology is shown by its containing a list of fossils from the Mountain Limestone. The founding of the Geological Society of Dublin, which flourished until 1888, now gave an impetus to observations round the city; and numerous papers were published in its Journal, including the first descriptions of the now well-known but problematic organism Oldhamia. The Geological Survey, under Prof. Jukes, issued in 1861 a memoir to accompany Sheets 102 and 112 of the map of Ireland. Some of the excellent sketches by Du Noyer, prepared for that publication, are reproduced, by kind permission of H. M. Stationery Office, in the present essay. The memoir to Sheets 121 and 180, covering Bray and the eastern part of County Wicklow, was issued in 1869, and is at present out of print. The one-inch geological maps are, however, obtainable, as follows:—92 (Drogheda); 101 (Trim); 102 (Portrane); 111 (country west of Dublin); 112 (Dublin); 120 (west of Wicklow mountains); 121 (Bray and the Sugarloaves); 129 (Baltinglass); 180 (Glendalough and Rathdrum). The editions of the above sheets made in 1901 contain revisions of the Silurian rocks. These sheets cost 3s. each. The new Drift-edition of Sheet 112 (Dublin) costs 1s. 6d. For pedestrians, the new Ordnance Survey one-inch sheets, with hill-shading and roads in colour, are recommended.

The geological details on the map accompanying the present volume have been reduced from the published sheets, with trifling modifications, in the office of the Geological Survey of Ireland, by permission of the Department of Agriculture and Technical Instruction.

In 1878 the Rev. Maxwell H. Close wrote on the geology of the district for the Guide issued in connexion with the third visit of the British Association, Mr. W. H. Baily

contributing an account of the palaeontology of the county of Dublin. A series of papers on the county was published in 1892 by the present writer in the first volume of the Irish Naturalist; and a more comprehensive description of "the Geology of Dublin and its neighbourhood" was contributed by Professor Sollas in 1895 to the Proceedings of the Geologists' Association.

Lastly, the area of the one-inch Sheet No. 112 of the Ordnance Survey is admirably covered, from a geological point of view, by the memoir on "The Geology of the country around Dublin," issued by the Geological Survey in 1903. A good bibliography of the geology of the Dublin district is included. Mr. G. W. Lamplugh, as District Geologist, at this date introduced into Ireland the systematic mapping of superficial deposits; and Mr. J. R. Kilroe, one of the authors of the memoir, has undertaken the description of these deposits for the present Handbook. Mr. H. J. Seymour, another of the authors, describes the mineralogy of the district; and the petrographic notes inserted in the following pages are also due to him.

SCENIC FEATURES.

The traveller, long before he enters Dublin Bay, is aware of the high moorland which stretches south-westward from the hollow where the Liffey emerges on the sea. Northward, the ground rises far more gently; and the prominent features in this direction are the peninsula of Howth, and the dome-backed island of Lambay. These are in reality outlying masses of the foothills that stand on the south side of the bay, between the shore and the long central range. As the steamer nears the harbour, these foothills detach themselves from their background; and the dark and mammillated promontory of Bray Head, the scarped peak of the Great Sugarloaf, and the boss of Carrickgollogan above Shankill, indicate the broken character of the coastland. Here and there, green fields, divided by hedges or by lines of trees, climb far towards the uplands, which are golden with furze or purple with the heather. On the moor, the grey rock

peeps out at intervals, and a few high quarries scar the mountain-side above Glencullen.

The gentler slopes, and the lowland of the Liffey, are in fact covered with drift-deposits, clays and gravels, partly local, but largely of north-western and northern origin. These form the lands seized on by the early settlers, as they strove to enter the country from the sea. The great moor beyond, where the passages through the foothills open into broader glens, gave shelter to the tribes successively dispossessed; and Bray and Cullen's Wood, on the junctions of the two types of scenery, became again and again the field of bitter contests. The grey castle-towers that for centuries marked out the limits of the English Pale do not pass beyond the mantle of the drift; and the high ground of Leinster, near the city, was for long a menace to the growing port of Dublin.

To follow the course of the Liffey is, however, to link the moorland with the plain. The river rises in a wild stretch of mountain-peat and grass and heather at a height of 1700 feet, and almost on the crest of the divide. It runs westward under Kippure, clearing out its course in its old valley, on which mountain-taluses have encroached. Where it should apparently flow northward, across the col at Brittas, it carves its way southward to Poulaphouca, where it forms a picturesque ravine as a reminder of its highland origin. Then the river meanders out into the great plain, to the fringe of the brown bogs of Kildare, whence it runs northward over a drift-covered lowland, and here and there forms rapids, as at Leixlip, and cuts into the limestone strata underneath. Mr. Lamplugh¹ has shown how its course, and that of its tributary, the Dodder, are quite modern features of the plain, and how traces of earlier channels lie hidden beneath the covering of drift.

While, by the gradual downsliding and removal of the boulder-clays and gravels, an older surface is being brought to light, this older surface has a double history of its own. In the lowlands, Carboniferous strata still remain, the

¹ Geol. Survey, Explanation of Sheet 112 (1903), p. 152.

residue of a series that once climbed high against the Leinster chain. But the chain itself, the great moorland and its foothills, existed already as a long island or a promontory in the Carboniferous sea; and the removal of the deposits of that sea by denudation is still revealing to us more and more of the configuration of a very ancient Ireland.¹

GEOLOGICAL FEATURES AND HISTORY.

What are the oldest rocks in the area with which we deal? The upthrust and folded slates and quartzites of Howth, and the corresponding rocks that form Bray Head and the country southward to Rathdrum, were long held to be overlain unconformably by the shales and sandstones nearer to the central chain. Considerable doubt, however, has been thrown upon the unconformity; and Mr. Lamplugh has recently compared the two series jointly with the continuous body of Skiddaw slates and with the Manx slates of the Isle of Man.² The suggestion that any part of this series near Dublin is of Upper Silurian age³ has no firm evidence to support it; and if any change is to be made in view of Mr. Lamplugh's remarks, the general feeling will probably be in favour of extending the borders of the area mapped as Cambrian. Bray Head is famous as the original site where Oldhamia was discovered,⁴ and the occurrence of similar objects in Cambrian strata in other parts of the world has greatly strengthened the original opinion as to the age of the **Bray and Howth series**. In view especially of Mr. G. F. Matthews' work on Cambrian worm-traces in Newfoundland (1890), the time has probably gone by when Oldhamia could be

¹ Compare Jukes, Memoir to Sheets 102 and 112 (1861), p. 24.

² Mem. to Sheet 112 (1903), p. 8. See also J. F. Blake, "Monian System of Rocks," Q. J. Geol. Soc. London, vol. xliv. (1888), p. 534.

³ Mem. to Sheet 112 (1903), p. 7.

⁴ T. Oldham, Journ. Geol. Soc. Dublin, vol. iii. (1844), p. 60; Forbes, *ibid.*, vol. iv. (1848), p. 20; and J. R. Kinahan, *ibid.*, vol. viii. (1858), p. 69, and Trans. R. Irish Acad., vol. xxiii., p. 547. For a review of later work on Oldhamia, including papers by Joly and Sollas, see Cole, Irish Naturalist, vol. x. (1901), p. 81.

considered as inorganic. While the quartzites on Bray Head, whether grey-green, or white, or brown, yield no such remains, the green and red slates, when they break along the bedding, show at certain points radial or, far more rarely, fan-like wrinklings. When one of these objects occurs in a bed, others are likely to be close at hand, and they often overlap abundantly on one another, repeating themselves in successive layers of the altered mud in which they lie. The strata at the north-east angle of Bray Head, which are best visited at low water, and occasional outcrops on the beach at Greystones, may afford good specimens of



FIG. 1.—The Needles, south side of Howth. Quartzite pinnacle, with diabase dyke at foot.

Oldhamia. Fine examples of these impressions, and the type-specimens of J. R. Kinahan's *Histioderma*,¹ a worm-tube with cross-markings, are to be seen in the Geological Survey collection in the Dublin Museum. *Oldhamia antiqua* has been found at Puck's Rocks on the north side of Howth; and Prof. Sollas² has described other problematic fossils from the same locality and from Bray.

¹ J. Geol. Soc. Dublin, vol. viii. (1858), p. 70.

² Sci. Proc. R. Dublin Soc., vol. viii. (1894), p. 297, and Quart. Journ. Geol. Soc. London, vol. lvi. (1900), p. 273.

These old rocks present very different features according to the amount of quartzite present. The pressures to which they have been subjected have often broken up the beds of altered sandstone; and the shales have flowed round detached blocks of quartzite, which assert themselves as features in the landscape. The flow-structure of the shales or slates, giving on fracture a series of mammillated surfaces, is again and again noticeable on Bray Head. At Howth, particularly on the uplands east of the harbour, the quartzite is so broken up in the shales that a breccia or false conglomerate has arisen. On the south side of the peninsula, however, the original bedding is easily traceable in the nearly vertical strata of grey, yellow-brown, or pinkish slates and quartzites. The fact that the quartzites in the Bray and Howth series were originally beds of sandstone has been admirably shown by Prof. Sollas¹; and T. Oldham² pointed out the occurrence of pebbles in the Bray quartzite as early as 1844. No one who examines with a pocket-lens the rock of Carrickgollogan, or of the summit of the Great Sugarloaf, will have any doubt as to these conclusions, though the bedding of the mass may often be difficult to trace.

The effect of the quartzites on the scenery is emphatic. The Great Sugarloaf (1659 feet) has all the beauty of a mountain-peak, and is the conical relic of an uplifted bed, which has saved large masses of the underlying slates from denudation. The dip is here eastward; and the quartzite appears also along the ridge between the summit and the Rocky Valley, and in several outlying knobs, such as that (776 feet) a mile and a half north-west of the Sugarloaf above the Dargle. The view from this latter point (in private grounds), in the heart of the tumbled and stream-cut country of the foothills, is even more striking than that from the Sugarloaf itself.

¹ "On the structure and origin of the Quartzite rocks in the neighbourhood of Dublin." *Sci. Proc. R. Dublin Soc.*, vol. vii. (1892), p. 169.

² "On the rocks at Bray Head." *J. Geol. Soc. Dublin*, vol. iii., p. 60.

The Little Sugarloaf (1120 feet), a ridge that stands up like a volcano when viewed end-on from the north, and the broken crest-line of the fort-like bluff of Bray, again illustrate the resisting powers of the quartzite. The inlying mass at Carrickgollogan (912 feet), associated with green shales and slates like those of Bray, and probably bounded by faults, and the serrated edge of Carrick Mountain above the railway to Rathdrum, similarly challenge attention in a land rich in attractive details.

The Bray and Howth series, which has also a large extension in County Wexford, may, then, be regarded as Cambrian, and as probably passing up into the shales, slates, and occasional sandstones which lie nearer to the centre of the Leinster chain. The latter series has been mapped as **Lower Silurian (Ordovician)**, and is certainly pre-Devonian, since it is involved in the great Caledonian earth-movements of early Devonian times. Unfortunately, fossil evidence is very scanty;¹ and the undoubted Ordovician areas lie as far removed from the central chain as Portrane on the north, the Chair of Kildare on the west, and Rathdrum (Slieveroe, &c.) on the south. Mr. R. Clark informs me that graptolites of Bala age have been found by him in the railway-cutting north-east of Rathdrum.

The chief interest of the slates of doubtful age lies in their metamorphism by the Leinster granite, as will presently be described. But their physical characters allow them to be deeply cut into by the streams descending from the moorlands; and the terrace which they might otherwise have formed along the chain becomes, in consequence, notched picturesquely and broken up into outstanding hills. The junction with the granite is often concealed by bogland or by drift; but sometimes it runs boldly up on to the moors, as at Douce Mountain (pronounced Djouse, rhyming with "house"), where it occurs west of the summit at a height of 2000 feet, and then traverses the rocky slopes above Lough Tay, in one

¹ See McHenry, Mem. to Sheet 112 (1903), p. 8.

of the most beautiful and broken landscapes in County Wicklow.

In the west of the chain, the Silurian strata form a picturesque tumbled country, directly beyond the Carboniferous limestone at Saggart. The tramway to Blessington and Poulaphouca climbs rapidly on to the foothills, and at the falls of Poulaphouca a good section of the strata is exposed. On the east rise the great domes of the Leinster granite, and on the west the limestone plain stretches away to the Bog of Allen, with the Ordovician inlier of Grange Hill and the Chair of Kildare standing out conspicuously above the level surface.

The promontory of Portrane and the island of Lambay afford surer geological ground, and have been studied in considerable detail.¹ The small Ordovician area exposed here as an inlier, bounded by the modern sea and by the Old Red Sandstone, contains abundant fossils of Middle Bala age. The uppermost limestone is probably on an Upper Bala horizon. The series begins with andesitic lavas, covered by an ashy conglomerate, the structure at the north end of the Portrane section being complicated by subsequent crushing and brecciation of the successive beds. This brecciation is still better seen among the limestones and shales in the centre of the section, which provide admirable demonstrations in physical geology, including overfolds, thrust-planes, faults, and "crush-conglomerates." The contemporaneous ash-beds of the lower stage have been omitted from the latest edition of Sheet 102 of the Geological Survey Map (1901); but their presence has recently been verified by Messrs. Gardiner and Reynolds, and by Mr. Seymour on Lambay. Microscopical evidence put forward by Prof. Sollas and others is, moreover, strongly in favour of their occurrence at Portrane, as was maintained by Jukes's original survey. The centre of eruption seems

¹ Mem. to Sheets 102 and 112, Geol. Surv. Ireland, ed. 2 (1875); Sollas, "Geology of Dublin," &c., Proc. Geol. Assoc., vol. xiii. (1893), p. 99; Gardiner and Reynolds, "The Portrane Inlier," Q. J. Geol. Soc. London, vol. liii. (1897), p. 520, and "The Bala Beds, &c., of Lambay Island," *ibid.*, vol. liv. (1898), p. 135; Seymour, "Geology of Lambay," Irish Naturalist, vol. xvi. (1907), p. 3, with coloured map.

to have lain to the east of Lambay. A handsome green porphyritic andesite or aphanite, with large tabular crystals of altered plagioclase, is known as the Lambay Porphyry, and intrudes at several places among the andesites on the island (see the maps of Messrs. Gardiner and Reynolds, and Seymour), and as a dyke in the lavas at the north side of Portrane. The dykes in the rocks of Howth and Bray, and some of the igneous masses near Rathdrum, probably belong to the same epoch as the volcanic products of Portrane. Others, however, of the intrusive rocks along the margins of the Leinster chain may be connected with the earth-movements of early Devonian times, and thus with the inflow of the granite magma.¹ Few fossils occur in the shales and limestones of Lambay ;² but Mr. Baily's list from Portrane in the Geological Survey memoir to Sheets 102 and 112, and Mr. F. R. Cowper Reed's report on the fossils collected there by Messrs. Gardiner and Reynolds,³ give us a good idea of the Ordovician fauna of the district. Those useful zone-fossils, graptolites, have been collected from a band of black shale north of the northern Martello Tower on the Portrane coast ; *Climacograptus Scharenbergi*, *Diplograptus*, and *Dicellograptus* are recorded. As Mr. Fearnside has pointed out to the present writer, the crushed black slate south of the same tower may some day yield graptolites that can be identified. Trilobites and brachiopods occur in the shale on the promontory south of the tower ; but the favourite hunting-ground for fossils is in the underlying limestone, which rises on the succeeding headlands further to the south. The abundant corals, including *Halysites catenularia* and several species of Favosites, have become silicified, and formerly stood out conspicuously on the weathered surface of the limestone. Quarrying operations have destroyed this surface to a considerable extent. Every block, however, of the limestone that may be broken off shows it to be as truly a mass of organic remains as is the

¹ See Sollas, Trans. Roy. Irish Acad., vol. xxix. (1891), p. 475 ; and Kilroe and McHenry, Q. J. Geol. Soc. London, vol. lvii. (1901), p. 488.

² Gardiner and Reynolds, Q. J. Geol. Soc. London, vol. liv., p. 137.

³ Q. J. Geol. Soc. London, vol. liii., p. 535.

familiar Carboniferous limestone. In the adjacent quarry, west of the footpath, the fossils are far less easy to distinguish.

South of the main limestone, which comes up in an anticline in the middle of the coast-section, crushed shales and limestones are well seen at the Priest's Cave, which is accessible at low water; and, thrust over them, we find a barren sandstone series, its bedding crossed by an imperfect cleavage. From analogy with rocks at Balbriggan, Messrs. Gardiner and Reynolds have suggested that these sandstones may be of Llandovery (Birkhill) age. South of them, beyond another band of thrust-conglomerate, limestones and shales reappear. Their relations with the andesites on the shore still further to the south are unfortunately hidden by a stretch of sand.

Mr. C. I. Gardiner¹ believes that the exposures at Balbriggan, in the extreme north of the county of Dublin, include Middle Bala beds, succeeded by andesitic lavas and contemporaneous ash, above which, as we go south-east from the town, graptolitic zones occur, indicating **Upper Silurian (Gotlandian)** strata of Llandovery and Wenlock age. The revision of these beds on the one-inch survey map, carried out by Mr. McHenry in 1901, recognizes, however, an anticlinal area of Bala beds south of Balbriggan, and throws all the strata north of the town into the Gotlandian (Llandovery to Wenlock series). Mr. Clark informs me that he has collected graptolites of Tarannon or Wenlock age in a quarry at Stadalt, near Stamullen.

It is clear, then, that the region where Dublin now stands was once covered by the early Palaeozoic sea, which found its shore far away in the north and west, but which was here probably unbroken, except by volcanic islands. At the close of Silurian times came that epoch of activity in the earth's crust which produced the "Caledonian" continent in the north-western region of Europe, and which caused a general unconformity between the Silurian and Devonian deposits. The latter were formed in fresh-water lakes in the greater part of the British Isles, the

¹ "Palaeozoic Rocks near Balbriggan," Geol. Mag., 1899, p. 398.

strata, with their brown and purple tints, being known as the Old Red Sandstone.

The Caledonian earth-pressures, operating from south-east to north-west, crumpled up the pre-Devonian rocks into a series of long folds, running from north-east to south-west, and marking out, at this remote epoch, some of the prominent features of our modern Europe. The ancient strata in the north-west Irish area were probably already converted into quartzites and crystalline schists; but they received, in early Devonian times, the trend which to-day characterizes the ridges of Donegal and the hollows in which the main streams run. Masses of granite, such as those above Glen Beagh and in the axis of the Ox Mountains, oozed up in their molten form into many of the huge rock-arches; and the Silurian strata, associated in the earth-movements, became in parts metamorphosed through contact with the invading magma. The conspicuous lines of earth-structure thus produced are traceable across Scotland and into Scandinavia; and the region now under discussion in the neighbourhood of Dublin still records the same movements in the pre-eminence of the Leinster chain.

This axis of elevation, which is now exposed over some eighty miles from Kingstown to Waterford, doubtless extends beneath the present Irish Channel, just as the axis of Newry to the north of it represents the prolongation of the Southern Uplands of Scotland. Along its flanks, the Silurian and Cambrian rocks were crumpled, and the shales passed into slates and wrinkled phyllites; but they did not become highly altered until the invasion of a granite magma took place from below. This inflowing material doubtless accompanied the general upfolding, working away at the flanks and crown of the great arch, and spreading in insidious sheets between the beds of shale and sandstone on its margin. Elongated strips of altered sediment occur in abundance in the granite west of Wicklow Gap and Glenmalure, as is well shown on Sheet 129 of the Geological Survey map of Ireland. Some of these schist-bands may represent the lower parts of pendants from the original dome, the material between

them having fallen away into the molten mass as it worked its way upwards.¹ Professor Sollas² believes that the intrusion took place in successive sheets, as the arch of sediments rose from time to time, the first mass having been of sufficient importance to effect great alteration in the adjacent Palæozoic strata. In the Dublin area, at any rate, the granite is never seen in contact with the Bray and Howth series—a fact that has led Professor Sollas to suggest that its form is that of a laccolite, i.e., that the mass has worked its way into the uprising dome, between an arch of Silurian and a floor of Cambrian strata.

The Leinster granite, a quartz-microcline-mica rock, with its broadly developed and often tabular joints, has weathered into a series of round-backed moorland hills, the highest point being south-west of Glendalough, where Lugnaquilla, capped by a relic of the sedimentary dome, rises to 3089 feet above the sea. Unless traversed by streams, the junction between the igneous rock and the altered sedimentary zone is not marked by any feature in the field. It runs, for example, across the smooth-sided hill on which Ballycorus chimney stands ; it climbs, as before mentioned, high upon the moor at Douce ; and it continues up and down hill across a succession of mountain-spurs. There is plenty of evidence, however, of the general parallelism of the marginal surface of the granite with the stratification of the overlying dome, since this stratification still remains marked in the altered sediments. This fact was long ago noticed by Jukes³ in a little section above Killiney (see fig. 2, p. 14). Where the contact-rock has been stripped off by denudation, the bare surface of the granite sufficiently indicates the former curving of the

¹ Compare C. Darwin, in 1846, on a junction of granite and schist near Cape Town, "Geol. Obs. on Volcanic Islands," Minerva edition, p. 264.

² "Contributions to a knowledge of the Granites of Leinster," Trans. R. I. A., vol. xxix. (1891), p. 506; and Proc. Geol. Association, vol. xiii. (1895), p. 108.

³ Mem. to Sheets 102 and 112 (1861), p. 32. See also Close, "Phys. Geol. of Dublin," Sci. Proc. R. Dublin Soc., vol. i. (1878), p. 142.

sedimentary dome.¹ Rev. Maxwell Close² very justly argued, from the relative widths of the metamorphosed zone at the surface on the two sides of the chain, that the granite face descends more steeply on the west than on the east. The original Leinster fold was therefore, in all probability, unsymmetrical.

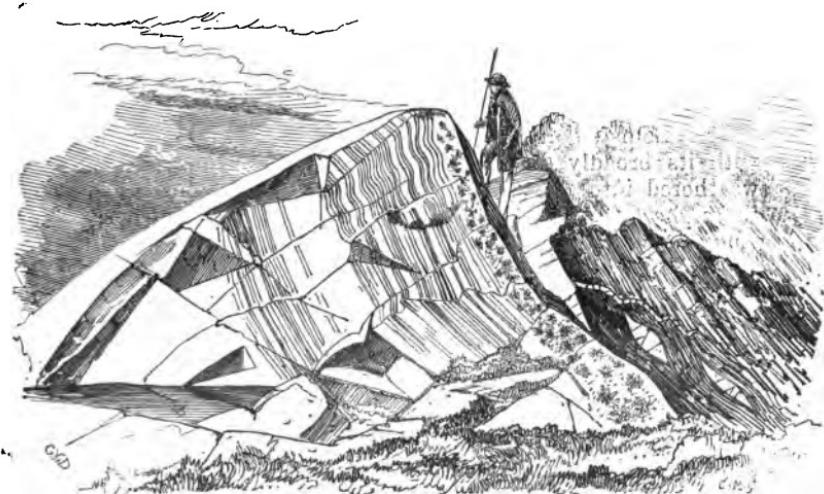


FIG. 2.—Junction of granite and mica-schist, north of Killiney Park, showing arrangement of mica in the granite.

Original flow in the consolidating granite magma undoubtedly arranged its minerals near the margin, with a general parallelism of their longer axes or their platy surfaces, and imparted to some crystals that ovoid form which makes them resemble "eyes" in the common flow-structure. In other places, as Professor Sollas³ urges, a closely similar structure has arisen through pressure acting

¹ Compare foot-note in Mem. to Sheet 112, edition of 1903, p. 58.

² "Phys. Geol. of Dublin," Sci. Proc. R. Dublin Soc., vol. i. (1878), p. 141.

³ Proc. Geol. Assoc., vol. xiii., p. 110.

on the already consolidated rock, producing a "crushing of the quartz, and the internal shearing of the whole rock along numerous gently undulating and intersecting surfaces which correspond to the planes of foliation." The microscope affords the only satisfactory means of distinguishing between flow due to igneous intrusion and that due to pressure after consolidation. The numerous cases, however, where the granite is more rich in dark mica near its margins, and where the darker material is arranged in layers parallel with the flow-structure of the mass, cannot be explained by either of the above suppositions. In such cases, it seems to the present writer that a composite origin must be ascribed to the rock,¹ the darker layers representing schistose flakes picked off and exfoliated from the sedimentary mass, as the marginal granite magma invaded it along the planes of bedding. Many such parallel flakes are large enough to be shown upon the one-inch geological map; and this interlamination was noticed in Glenmalure by Weaver as far back as 1818.² Veins and elongated knots of granite commonly appear, moreover, within the area of the altered sediments, intruded along their planes of foliation, as may be seen in the roadway from Rockbrook to Mount Venus, and in very many other places as one nears the junction-line drawn upon the map. The streaky granite, a true banded gneiss, so well seen, for example, in Glenmacnass, seems the natural result of the process known as *lit par lit* injection. Mr. Seymour,³ while not committing himself to this explanation, suggests that, in the well-known section above Killiney (fig. 2), the hornblendic rocks (epidiorites) associated with the altered sediments have provided the biotite of the darker bands seen in the granite.

Numerous veins (eurite and aplite), often containing small garnets, traverse the main granite, and represent the

¹ Compare "On a Hillside in Donegal," Science Progress, vol. i. (1906), p. 348.

² Trans. Geol. Soc., ser. I., vol. v. (1821), p. 117.

³ Mem. to Sheet 112, edition of 1903, p. 22.

last upwellings of molten matter, as the earlier masses cooled and shrank.

The junction of granite and **mica-schist** on Killiney strand is easily reached by walking along the coast-road from Dalkey station, and crossing the railway by an iron foot-bridge. Here Professor Jukes first studied the contact-features of the Leinster chain. The upthrust and altered sediments are traversed abruptly by the granite of Killiney Hill, which sends off dykes and veins into them. The largest dyke rises along the foliation-planes, which are here clearly the planes of bedding, and then cuts across them, appearing horizontally on the cliff-face. The original composition of the various beds has obviously influenced their mode of alteration. All are highly micaceous; but in some zones andalusite has developed in knots and stellate groups of slate-grey rod-like crystals, and now and again, with more distinct outlines, as white chiastolite. Garnets also occur, often represented by rusty casts on exposed faces of the rock. The same minerals occur everywhere along the contact-zone, and andalusite, in large pink prisms, has been found handsomely developed at Lugduff, south of Laragh.¹

Mr. H. J. Seymour has supplied the following description of the metamorphism of igneous rocks by the Leinster granite:—"On the margin of the granite massif, within the area under notice, and chiefly on the west side, a number of dykes of basic andesite occur, which have been altered in various degrees. There are three types of alteration noticeable, the original rock being practically the same in all cases. In those masses which lie at the greatest distance from the contact zone, and which have only just come within the area affected by the granite, the alteration is slight and consists essentially of the conversion of the original augite-andesite into an epidiorite, the general structure of the rock being retained.² Nearer to

¹ Von Lasaulx described the metamorphosed sediments in Tscherm. Mittheil., Bd. i. (1878), p. 435.

² See Seymour, "Summary of Progress," Geological Survey of the United Kingdom, for 1898-99, pp. 64 and 176 et seq.

the contact zone, as at Carrickgower Bridge, the original andesite is converted into an amphibolite, with fairly coarse structure, while certain other porphyritic andesites of a more compact structure show the effects of thermal metamorphism in the conversion of the paramorphic hornblende into a dark biotite mica. The igneous rocks occurring close to the granite show naturally the greatest changes, having been subjected to both thermal and dynamic metamorphism. On the intrusion of the earlier of the granite sheets, which, according to Professor Sollas, build up the Leinster laccolite, these basic igneous rocks were first converted into epidiorites and then into biotite-epidiorites. At this stage they became subjected to intense shearing movements, which, as can be shown in the case of the rocks at Donard and the vicinity (Co. Wicklow), resulted in the ultimate production of biotite-schists. Near Donard, the original rock being coarsely porphyritic, one is able to follow all the stages in its dynamic alteration.¹ Briefly, the first effect noticed is the more or less parallel rearrangement of the porphyritic crystals of labradorite; then follows the drawing out of these crystals by 'strain-slip fracture,' whereby they are broken up, ground to powder, and recrystallized in granules, finally appearing as flat leaf-like forms six or more times the length of the original crystals, and with a corresponding reduction in their thickness. The small mica crystals have during the same time increased considerably in size. On the east side of the granite, near Killiney, a compact hornblende-schist occurs of the type described by Teall² as resulting from the metamorphism of the Scourie dyke, and it has been described by the late Professor J. P. O'Reilly,³ who originally discovered this rock. Further south, in the neighbourhood of Glendalough, is an interesting metamorphosed rock, rich in hornblende, which Professor Sollas has described."⁴

¹ Seymour, *Sci. Proc. R.D.S.*, vol. ix. (1902), p. 568.

² Teall, "British Petrology," p. 197.

³ O'Reilly, *Proc. R.I.A.*, Ser. 3, vol. vi. (1900), p. 19.

⁴ Sollas, *Report Brit. Assoc.*, 1893, p. 765; *Proc. Geol. Assoc.*, vol. xiii. (1893-4), p. 111.

The marginal band of mica-schist accompanies the granite of Leinster throughout its length. Though not indicated by any striking feature upon the moorland-surface, as we have remarked already, it is at once recognized on the walls of any of the transverse valleys. In these the weathering develops the stratified structure, which is also that of the foliation,¹ and the altered rocks stand out in dark bands, in contrast with the smooth slopes of the adjacent granite. The rocky walls above the Upper Lake of Glendalough, and the long tongue of schist on the west side of the wild pass of Wicklow Gap, afford typical scenery of this kind.

Where the rivers cross the boundary between the granite and the schists, they begin to cut ravines, which arise still more noticeably in the slates of the Bray and Howth series. The rocky drops at the Powerscourt Waterfall, at Lough Tay, and at the head of Glenmacnass, thus indicate the change of bed-material. The cañon of the Dargle at Enniskerry, and the beautiful Devil's Glen, where the Vartry descends from Roundwood, are both of them cut through the Bray and Howth series, and have no parallel in the granite region.

The Leinster chain furnishes Dublin, and a considerable area south-east of the city, with a superb water-supply. This is gathered in the reservoir of the Corporation in the basin of the Vartry River on the sedimentary series at Roundwood, twenty miles south of the city, and 740 feet above the sea. Some of the southern townships near the city obtain their water from another reservoir, where the Dodder is captured in the deep drift-filled valley of Glenasmole, which stretches into the mountains south of Tallaght. The water in this case rises on the granite slopes below Kippure.

When our eyes travel above the cultivated drift-mounds and the wooded taluses on the slopes immediately south of Dublin, we perceive at once the characteristic features of the granite core. A good road, too little known to visitors, runs from Rockbrook eastward to the top of the hill above

¹ Compare Jukes, "Manual of Geology," ed. 3 (1872), p. 229.

Dundrum. On one hand the ground drops quickly to the plain of the lower Dodder and the Liffey, while, beyond the smoke-dimmed towers of Dublin, the limestone country rises, and spreads as a broad plateau to the north. On the south, granite everywhere prevails, and the white rock shows freely through furze and woodland on Kilmashogue, and is largely quarried, by a community of cottagers, high upon the slopes of Three-Rock Mountain. Here we traverse the old Slieve Roe, the northern buttress of the moorland, which still offers close to Dublin the welcome freedom of the heather. Small tors, like those of Dartmoor, occasionally crown the summits; but crags are rarely seen in this ancient and worn-down ridge of Leinster.

The glens cut in the granite by the transverse streams have broad and glaciated floors, into which sweeping and overgrown taluses descend. High up, on the domed summits, the cracked and diminishing peat slides away from the crumbling rock, and a coarse sand of quartz, felspar, six-sided plates of mica, and granite fragments, is developing in its place. The roots of trees in the natural sections of the peat show how a forest-epoch preceded the damper one, during which the upper layers of the peat accumulated. At present, as is common throughout Ireland, and probably throughout Europe generally, a drier epoch has set in; and the bare grey patches of granite on the moors of Leinster continue to spread from year to year.

These great desolate moors, which have never been inhabited,¹ make a profound impression on those who care to traverse them. It is a familiar climb from Dublin over five stiff miles of the Military Road, engineered across the heads of the glens soon after 1798, to the heather-plateau of Killakee Mountain. After a drop into Glencree, the road winds boldly up beside the glacial cirques of the two Loughs Bray; and then, crossing the infant Liffey, we descend to the pass of Sally Gap (1684 feet). The next eight miles of the road, with no shelter on it but a keeper's lodge, afford some of the wildest land-

¹ Compare map in R. Fraser, "General view of the agriculture and mineralogy, &c., of the County of Wicklow," Dublin (1801).

scapes in the chain ; and a certain relief is experienced, if the day is gloomy and the clouds stream down from the great domed masses on the west, when we see below us the first white farms on the schistose floor of Glenmacnass.

Mr. H. J. Seymour contributes the following account of the intrusive rocks on the margin of the Leinster chain :—
“ In the southern portion of the district, lying mainly well to the east of the granite, are a number of dykes of igneous rock of two different types, acid and basic, and, like the granite, intrusive in the Silurian slates and shales. The basic types are chiefly sheared andesites, and have been examined by Hatch and others in detail. They were formerly, on account of their apparently bedded structure, regarded as ashes, and were mapped as such by the original workers in this district. Hatch,¹ however, correctly determined them to be sheared igneous rocks and mainly hornblende-schists; and it is doubtful if any ashes occur in the area at present dealt with.

“ The acid types also, for like reasons formerly regarded as volcanic ashes, are now known to be sheared felsites, which are frequently porphyritic. They are more interesting types than the basic rocks, and fall into two groups, potash-felsites and soda-felsites, or keratophyres, the former predominating. They represent the hypabyssal phase of the potash- and soda-granites, which occur as outliers on the eastern side of the main granite mass, but chiefly south of the present district. These felsites show many of the characteristics of lava-flows : some of them, as at Arklow, are beautifully fluidal; others show spherulitic and perlitic structures, and, except for their obvious devitrification, closely resemble modern rhyolites.”

The Leinster chain, then, and its foothills, with the outlying Silurian exposures at Portrane and Balbriggan, represent in our area the Caledonian continent, the earliest land-surface that we know in eastern Ireland. The rivers entering the **Devonian** lakes deposited the **Old Red Sandstone** in the hollows of this continent, and the lake-floors sank under the load of conglomerate, sand, and shale

¹ Hatch, Mem. to Sheets 138 and 139, Geol. Survey (1888), p. 49.

until a vast thickness had accumulated. South-west of Dublin, conglomerates that probably belong to the Old Red Sandstone series occur between Newcastle and Kill, but are poorly exposed. Jukes¹ estimated their thickness, as they abut on the Silurian slates, as not more than 200 feet. Similar conglomerates of pebbles of quartz and quartzite are found stretching across the Portrane promontory, and were formerly well seen close to the railway-station of Donabate. They emerge on the north shore of the promontory, where their relations to the Ordovician lavas are obscure, and also in Broad Bay in the north-west corner of Lambay.² The horizon of the Carboniferous beds that overlie them is probably a low one; but the conglomerates themselves may possibly be of Lower Carboniferous age, as Mr. G. H. Kinahan³ has always held. Professor Sollas⁴ also regards them as marine beaches, formed on the flanks of the Caledonian mass that united the mountain-lands of Wales and Ireland. A residual patch, too small to be represented on the map in this Handbook, occurs at the south end of Shenick's Island, and another occurs at Stamullen, west of Balbriggan.

The land sank steadily in **Carboniferous** times, and it is probable that the Leinster highland became entirely submerged. It had already, however, undergone prolonged denudation, and pebbles of granite and flakes of micaschist have been found in the muddy Carboniferous limestone in several quarries to the south of Dublin.⁵ The dark argillaceous limestone is locally known as "calf," a name introduced into scientific literature by Kirwan. On exposure, it often reveals a shaly structure, by removal of the calcium

¹ Memoir to Sheet 111, Geol. Survey (1860), p. 15.

² See Seymour, Irish Naturalist, 1907, p. 10, and Plate 5.

³ "Manual of the Geology of Ireland" (1878), p. 64. See also Cole, "County Dublin," Irish Naturalist, 1892, p. 73.

⁴ Proc. Geol. Assoc., vol. xiii., p. 112.

⁵ Haughton, "Notice of the occurrence of fragments of Granite in Limestone," Journ. Geol. Soc. Dublin, vol. v. (1851), p. 113; Montgomery, "Granite in Limestone near Rathfarnham," Journ. R. Geol. Soc. Ireland, vol. i. (1864), p. 15; and Geol. Survey Memoir to Sheet 112 (1903), pp. 77 and 10.

carbonate that bound the whole together ; and black clay-residues of this type of limestone, which have become porous and very light, are common as pebbles in the glacial gravels. The mud of the calp, no doubt, represents the downwash from the Caledonian land, where slates and shales sent their detritus into the sea, just as they do from Howth and Bray Head at the present day.

Conglomerates, true sea-beaches, were formed locally, and at various horizons, in the Carboniferous system, and became intercalated with the organic deposits that gave rise to limestone. On the promontory of Rush, east of the village, a good example occurs, and a more conspicuous bed lies almost parallel with the modern beach-surface south of Skerries. In the latter case, the Silurian beds are close at hand, and the conglomerate of blocks worn from them is one of the many evidences of what may be called the Caledonian unconformity.

The highest Carboniferous beds in our area are certain outlying patches between Dublin and Drogheda, represented on old maps as Coal-measures, but referred by the Geological Survey, about 1876, to "Millstone Grit and Yoredale Beds." On the map accompanying the present volume they are described as "Shale and Sandstone Series above the Limestone"; and Dr. W. Hind has included them in his Pendleside Series.¹ The black shales of this series, rich in *Posidonomyia Becheri*, are seen in contorted synclines on the Loughshinny coast, where crumpling and overfolding may be studied in the solid, not merely in section; the anticlinal arches and synclinal "spoons" of the underlying "Upper Limestone" here run out at right angles to the shore. The dark clayey and cherty rocks, once referred to the Upper Shale series, between Rush and Brook's End, have been shown by Dr. Matley² to represent locally a zone in the limestone, from which the calcareous matter has been dissolved away.

In the paper just quoted, Dr. C. A. Matley and Dr. A. Vaughan have examined the fossil evidence near Rush,

¹ Q. Journ. Geol. Soc. London, vol. lvii. (1901), p. 375.

² "Carboniferous Rocks at Rush," *ibid.*, vol. lxii. (1906), p. 293.

and have shown that the beds here range from the Upper Zaphrentis-zone to the Upper Dibunophyllum-zone. The fossils are carefully noted, and referred to their respective horizons.

The same authors have also described the Carboniferous sections towards Skerries, and have reconsidered the Rush area, in a paper read before the Geological Society of London in 1908.

Two of the principal quarries from which Dr. A. H. Foord¹ gathered his fine series of Carboniferous cephalopoda lie in the area dealt with in this Handbook; St. Doulagh's is reached from Portmarnock station, which lies some two miles east of it; and Clane is in the plain of Kildare, about four miles north of Sallins.

On the shore between Skerries and Rush, at Sutton near Howth, and at other places, brown dolomite has occasionally arisen through chemical alteration of the limestone.

Flint (chert) is also common, in irregular pseudomorphic masses, or in beds enclosing casts of the larger fossils, such as crinoid-stems, which escaped replacement by the silica.

In the Kilkenny coalfield, a high synclinal outlier resembling the Forest of Dean, rising on the west side of the Leinster chain, true Coal-measures occur above a considerable series of grits and shales. The next Coal-measure outlier lies above Kingscourt, far away on the Meath and Cavan border; but there is reason to believe that the elevation of the sea-floor towards the close of Carboniferous times allowed of a general growth in our area of those great forests to which we owe our coal-seams. But this elevation continued; a crumpling of the whole system of rocks set in; and at the same time denudation was active in working against the crests of the new "Hercynian" mountain-chains. Even the Old Red Sandstone, involved in the same crumpling, became revealed in

¹ Palaeontographical Society, volumes for 1897, 1898, 1900, 1901, and 1903.

anticlinal folds. In places, as in Slieve Bloom, the crests of these folds were cut through still further, and the unconformable Caledonian land-surface, underlying the sandstone, once more lay exposed, as part of the new Hercynian continent, which stretched eastward through the European region.

The main axes of folding ran in this case from east to west, as is exemplified in their general arrangement in the north of the county of Dublin; but the Leinster chain, which had been moulded so long ago, and which was strengthened by its granite core, served as a groyne to divert the earth-waves as they pressed forward from the south. The Hercynian folds along the west side of the chain conform, therefore, to the Caledonian trend, as may be seen in the Slieve Ardagh and Kilkenny coalfields, and in the Devil's Bit and Slieve Bloom axis, which rises from the central plain.

We have no clear proof that the south and centre of Ireland were ever again invaded by the ocean from the opening of Permian times to the present day. Relics of marine Permian deposits occur, however, in the counties of Down and Tyrone. A continental type of Trias follows, and red sandstones and marls of this age doubtless extended over the Dublin area. The great European sea of Jurassic times reached the counties of Antrim and Londonderry, probably across Cheshire, or perhaps from the north, where it has left its traces in the Inner Hebrides. In the latter and less probable case, a shore may have been formed by the Caledonian axis of elevation that runs from County Longford into the Southern Uplands of Scotland, and the greater part of Ireland may have remained free from submergence. Similarly, the mid-Cretaceous transgression led to the deposition of sandstone and chalk in the north of Ireland. These beds are protected, like the feeble representatives of the Jurassic, by a later covering of basaltic lava. Cretaceous flints abound in the drift-gravels of the Dublin area; but all of them may have been imported during the Glacial epoch. The remarkable distribution, however, of flint- and chalk-fragments in the Atlantic floor off the west of Ireland, as revealed by the recent

dredgings of the Fishery Branch of the Department of Agriculture, points to true Cretaceous deposits in other places than in the north. It is fully recognized, moreover, that the present limits of the Chalk in the Britannic area result from the action of denudation, which prevailed in many localities throughout the whole of Cainozoic time.

Cainozoic dykes are unknown in the south-east of Ireland, whence we may conclude that the surface was not covered by lava-flows, such as those which form protective plateaus in the north. Our Carboniferous deposits, then, have undergone almost continuous denudation during the Cainozoic era ; they were, moreover, greatly attacked throughout the Irish area, as may be seen in the Dungannon coalfield, before the Triassic beds were laid down. A peneplain has resulted, extending over the whole of central Ireland, and reaching to the sea at Dublin and Galway Bays. The more resisting masses of the Old Red Sandstone and the Leinster chain stand out as great bars upon its surface, but are destined also to decay, unless elevation again sets in. We owe to Professor W. M. Davis this substitution of the peneplain, a surface of subaerial wasting, for the older conception of a " plain of marine denudation "; and there is now no reason to attribute the uniformity of the surface of our Carboniferous deposits to any subsidence leading to an invasion by the sea. The Carboniferous limestone is easily removed in comparison with many of the rocks associated with it in the earth-folds ; and hence a perfect plain has not been attained in central Ireland. But over wide areas the limestone is the prevailing material ; and between Dublin and Galway few hills are seen except those formed by eskers and other types of glacial drift. In cliffs like those on the Boyne at Béauparc, or on the shore at Loughshinny, south of Skerries, we may note the intense crumpling of the limestone strata, and may realize how this has counted for nothing in producing features on the present denuded surface.

This great plain of Ireland, which is cut into by the sea-coast near Dublin, possesses, however, the general character of a broad syncline ; and the Carboniferous strata were

lowered somewhat in this region, while they appeared for a time on the crests of high arches in the south. As we have already seen, this lowering has not saved the Upper Carboniferous beds from denudation, outliers alone being now left of a series that no doubt once overlapped and concealed the whole Carboniferous Limestone in this area.

So far, the essential features of the Dublin district are due to geological events of high antiquity. The most profound modification of the surface-conditions took place, however, during the **Glacial epoch**.

The description of the advance and recession of the ice, and of the features that it has left behind, has been undertaken by Mr. J. R. Kilroe, one of the authors of the Survey Memoir on the Geology of the country around Dublin, and of the revised Sheet 112, on which the drift-deposits were first portrayed in detail.

GLACIAL DEPOSITS.

By J. R. KILROE, A.R.C.S.C.I.

EXAMPLES of the manifold indications that testify to a succession of glacial and post-glacial phenomena throughout the British region during post-Pliocene times occur within a comparatively small area lying to the north, west, and south of Dublin; and many of the most interesting problems arising out of the distribution of the drifts are encountered here. Little that is new remains to be added, to throw light upon the features presented in this well-travelled area. The writer's task is to present, in a convenient form, facts already well established, and the hypotheses by which they are best to be accounted for; and happily, in the carrying out of this purpose, his personal knowledge of the ground can be supplemented by appeals to an extensive literature.

Observations by intelligent investigators date back to the thirties of the last century, when John Scouler¹ wrote

¹ Journ. Geol. Soc. Dublin, vol. i., pp. 266-276, and Proc. Geol. Soc. Lond., vol. ii., pp. 435-437.

"On certain elevated Hills of Gravel, containing Shells, in the Vicinity of Dublin"; and when Joshua Trimmer described certain relations of these drifts—as seen at Bray, Howth, and Glenasmole—to those on the opposite side of the Irish Sea.

In the forties, Thomas H. Porter,¹ Thomas Oldham,² G. V. Du Noyer,³ and (Sir) R. Kane⁴ were at work on the superficial deposits, as well as upon other details of the geology of this interesting region.

In the fifties, John Kelly⁵ described the drift of the district about Rathfarnham, in the county of Dublin; and J. R. Kinahan⁶ gave an account of the "Fossils from the Marine Drift of Bohernabreena, County Dublin."

In the sixties was issued the Explanatory Memoir of the northern part of the present region (Geol. Survey, Sheets 102 and 112), by J. B. Jukes and G. V. Du Noyer (first edition). In 1862, James Smith⁷ described what he named "Elevated Marine Beds," Howth and Bray beds, &c. Two years later Rev. Maxwell H. Close⁸ read his paper on the "General Glaciation of the Rocks in the neighbourhood of Dublin"; and G. H. Kinahan⁹ wrote in 1866 "Notes on some of the Drifts of Ireland."

In the seventies E. Hull¹⁰ published "Observations on the General Relations of the Drift Deposits of Ireland to those of Great Britain," referring to the drifts of Dublin; and, following this, G. H. Kinahan¹¹ discussed the Middle Gravels (?) of Ireland. A. Bell¹² described the

¹ Proc. Roy. Irish Acad., vol. ii., pp. 37-40.

² Journ. G. S. Dub., vol. iii., pp. 61-71.

³ *Ibid.*, p. 255.

⁴ "Industrial Resources of Ireland," 8vo, Dublin.

⁵ Journ. G. S. D., vol. vi., pp. 133-165, map, &c.

⁶ *Ibid.*, vol. viii., pp. 87-88; also Nat. Hist. Review, vol. v., pp. 167-168.

⁷ "Researches in Newer Pliocene and Post-Tertiary Geology," 8vo.

⁸ Journ. Roy. Geol. Soc. Ireland, vol. i., pp. 3-13, pp. 91-93; Dublin Quart. Journ. Sci., vol. v., pp. 177-187.

⁹ *Ibid.*, vol. i., pp. 191-207, and Dub. Quart. Journ. Sci., vol. vi., pp. 249-265.

¹⁰ Geol. Mag., vol. viii., pp. 294-299.

¹¹ *Ibid.*, vol. ix., pp. 265-268.

¹² *Ibid.*, vol. x., pp. 447-453.

"Palaeontology of the Post-Glacial Drifts of Ireland"; M. H. Close,¹ the "Elevated Shell-bearing Gravels near Dublin"; G. H. Kinahan,² the "Glacialoid or Re-arranged Glacial Drift; Irish Drift³—sub-group, Meteoric Drift; Irish Drift⁴—sub-group, Aqueous and Glacial Drifts"; and M. H. Close⁵ referred to the drifts in his "Physical Geology of the neighbourhood of Dublin," a paper that was written for the British Association Guide to the County Dublin, in 1878. A second edition of the Explanatory Memoir accompanying Sheets 102 and 112, by E. Hull, was published in 1875; a paper on the origin of the Scalp,⁶ and one on the "Geology of the Environs of Dublin," by the same author,⁷ in 1878; and in this year also a "Manual of the Geology of Ireland," by G. H. Kinahan.

In the eighties, G. H. Kinahan⁸ wrote on the Boulder-clays and Associated Gravels; Carvill H. Lewis,⁹ "Comparative Studies upon the Glaciation of North America, Great Britain, and Ireland"; A. Bell, Second¹⁰ and Third¹¹ Reports of the Committee upon the Marine Gravels of Wexford.

In the nineties, the Fourth¹² Report of the Committee just mentioned appeared, as did also "Physical Geology and Geography of Ireland," by E. Hull (second edition); articles by G. A. J. Cole on "County Dublin Past and Present,"¹³ and on Glacial Drift of the Irish Channel,¹⁴ including first notices of Ailsa Craig rock at Killiney, and Greenore.¹⁵

¹ *Journ. Roy. Geol. Soc. Ireland*, vol. iv., pp. 36–40; *Geol. Mag.* dec. 2, vol. i., pp. 193–197.

² *Ibid.*, pp. 111–117, 169–174.

³ *Journ. R. G. S. I.*, vol. iv., pp. 115–121.

⁴ *Ibid.*, pp. 210–218.

⁵ *Sci. Proc. Roy. Dub. Soc.*, vol. i., pp. 133–161; *J. R. G. S. I.*, vol. v., pp. 49–77.

⁶ *Sci. Proc. R. D. S.*, vol. i., p. 11.

⁷ *Geol. Mag.*, dec. 2, vol. v., pp. 457–460.

⁸ *Sci. Proc. Roy. Dub. Soc.*, vol. iv., p. 207.

⁹ *Rep. Brit. Assoc.*, 1886, p. 632. ¹⁰ *Ibid.*, 1888, pp. 133–141.

¹¹ *Ibid.*, 1889, pp. 92, 93.

¹² *Ibid.*, 1890, pp. 410–424.

¹³ *Irish Naturalist*, vol. i., pp. 9, 31, 53, 73, 90.

¹⁴ *Nature*, vol. xlvi., p. 464.

¹⁵ See also Dublin Microscopical Club, in *Irish Nat.*, vol. ii., p. 172.

In this decade appeared further contributions from Carvill Lewis, papers and notes on the Glacial Geology of Great Britain and Ireland¹; as well as papers by T. Mellard Reade on the "Dublin and Wicklow Shelly Drift,"² and on the "High and Low Shelly Drifts around Dublin and Bray"³; by W. J. Sollas, on the "Geology of Dublin and its neighbourhood"⁴; and by the same author, in conjunction with R. Lloyd Praeger, on "Glacial Deposits in Ireland."⁵ In 1897 M. H. Close⁶ wrote on the former abundance of Granite Boulders in the south-east neighbourhood of Dublin; and in 1902, W. B. Wright described the Glacial Origin of Glendoo.⁷

The "Summary of Progress" of the Geological Survey for 1901—issued 1902—contains an account of the Dublin Drifts; in 1902, J. de W. Hinch published a "Contribution to the Glacial Geology of the County Dublin"⁸; and W. B. Wright described some results of the Glacial Drainage around Montpelier Hill, County Dublin.⁹

In the following year, 1903, was issued the "Geology of the country around Dublin," a memoir explanatory of the Geological Survey Drift-Map of the Dublin area, Sheet 112, surveyed in 1901 under the supervision of G. W. Lamplugh, F.R.S., and the direction of J. J. H. Teall, F.R.S., which gives a comprehensive and detailed account of the superficial deposits of the country some six miles around Dublin on the north, west, and south, and eight miles towards the south-west and south-east. The drifts of Lambay have since been described and mapped in detail by H. J. Seymour in his account of the Geology of Lambay, and have been also described by J. de W. Hinch, who gives a list of the included shells in the boulder-clay.¹⁰

¹ London and New York, 8vo, 1894, pp. 83–166.

² Proc. Liverpool Geol. Soc., vol. vii. (ii.), pp. 183–206.

³ Irish Nat., vol. iii., pp. 117–121, 150–153.

⁴ Proc. Geol. Assoc., vol. xiii., pp. 91–122.

⁵ Irish Nat., vol. iv., pp. 321–329.

⁶ *Ibid.*, vol. vi. (1897), p. 29. ⁷ *Ibid.*, vol. xi., pp. 96–102.

⁸ *Ibid.*, vol. xi., No. 10, pp. 229–236.

⁹ Sci. Proc. Roy. Dub. Soc., vol. ix., pp. 575–582.

¹⁰ Irish Naturalist, vol. xvi. (1907), pp. 7 and 14.

CONFIGURATION OF THE SURFACE.

The region treated of in the present description extends some eighteen miles to the north, twenty-four to the south, and about six miles to the west of the city. The inequalities of its surface not only promoted a diversity in the drifts, but also to a great extent affected their distribution. We have a plain, averaging 250 feet in height, stretching away north and west from Dublin, bordered on the east by a marine channel some 50 to 70 fathoms in depth; and from the plain rises somewhat abruptly an elevated ridge, culminating in Lugnaquila, 3039 feet, and dropping away eastward in an irregular series of ridges and broken ground, with occasional conical masses, towards the sea. The ridge terminates northward in Three-Rock Mountain (1479 feet), against which, in the glacial epoch, an ice-mass abutted, probably of sufficient thickness at its maximum stage of development to overtop the summits of the Dublin hills.¹ In its sluggish movements, chiefly south-eastward, though probably also at one period south-westward, the mass also encountered the lesser eminences bordering the Channel, Howth Hill (560 feet) and the Killiney group (512 feet), the present sentinels of Dublin Bay, between which the Liffey had formed a pre-glacial outlet at least some 60 feet in depth below the low-water level of the present day.

The melting and decline of this great ice-mass would be attended with the formation of fluvial deposits on the surface of the ice, which, as the mountains and prominences just named became cleared of ice, would assume, in proximity to them, the character of more or less well-washed gravels, such as are at present to be seen along

¹ Rev. M. H. Close has recorded the occurrence of far-travelled boulders of limestone and white sandstone at 1760 feet elevation on the Fairy Castle summit of Two-Rock Mountain; and he stated that "there are some facts which make it scarcely rash to conjecture that at one time the glacial stream may have moved right across the long ridge of the Dublin, Wicklow, and Wexford mountaine, viz., the remarkable rounded outlines of those mountains even to the summit of Lugnaquila itself." *Journ. Roy. Geol. Soc. Ireland*, vol. i. (1864-1867), p. 10.

the flanks of the Dublin and Wicklow range, as well as embanked against Killiney and Howth hills, and also margining areas of rock which protrude above the general level of the drifts in the low ground.

DUBLIN AND WICKLOW DRIFTS.

Boulder-clay.—The prevailing variety of drift, to be seen in numerous shallow openings throughout the region, is boulder-clay; and it is frequently to be seen in deep sections, sometimes exceeding 100 feet in thickness. It usually consists of dark-grey tough calcareous clay, studded with smoothed and scratched boulders and pebbles of limestone, and a few other kinds of rock. This boulder-clay, with exceptions to be noted, has obviously been mainly derived from the Carboniferous limestone of the area stretching inland from the Dublin coast; and it wraps itself round the Dublin range, rising to heights of some hundreds of feet upon its slopes—to 1090 feet and 950 feet in the valleys of Larch Hill and Ticknock respectively.

Boulder-clay of purplish and reddish brown colours is also to be met with in this region, containing comparatively few limestone boulders or pebbles, but many suggestive of a northern origin, such as chalk and chalk-flints, Lias limestone, with corresponding fossils, and fragments of the characteristic rock from Ailsa Craig in the mouth of the Firth of Clyde. The importance of this rock in the drifts of the Irish Channel area was first noticed by Prof. P. F. Kendall. The purple boulder-clay contains foraminifera and numerous marine shell-fragments, some of them striated; and it is as strongly calcareous as the Antrim boulder-clay, which it closely resembles, where this is in most part derived from New Red Marl. Such boulder-clay occurs, for instance, between Belfast and Lisburn. The reddish brown clay is usually more sandy than the purple, is less calcareous, or even non-calcareous, and contains detached masses of the purple clay, as may be seen along the Killiney cliffs—from which facts it is inferred that the reddish brown clay is a rearranged representative of the purple boulder-clay.

Both the reddish and dark grey varieties sometimes

contain so great a percentage of rounded pebbles that they may be described as clayey and shingly gravels, as may be seen in a few sections between Shankill station and the shore of Killiney Bay. Such gravelly drift forms great mounds bordering the coast at Skerries; and southward of Dublin it occurs in the ground between the Wicklow hills and the sea.

On the higher ground, where the rock is concealed by shallow drift, the underlying rock—mica-schist, granite, slate, or quartzite—contributes materially to the admixture forming the covering, giving to the boulder-clay in those places a local appearance. Between the granite outcrop and the ridge of Carrick Mountain, granitic detritus covers

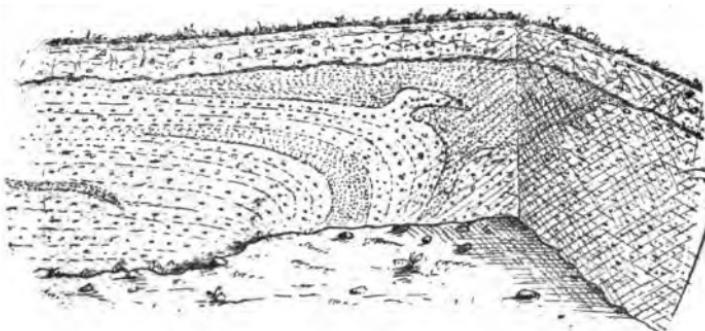


FIG. 3.—N.-W. corner of Johnstown and Kill-o'-the-Grange sand-pits. Boulder-clay (including soil, 9 inches; sub-soil, 1 foot 6 inches; undecalcified clay, 1 foot 9 inches); resting upon contorted sand and gravel, a yellow oxidized zone intervening. Geol. Surv. Memoir to Sheet 112 (1903), p. 112.

the lower ground, rising to a height of 1150 feet at Moneystown Hill. Here the underlying rock is mica-schist and slate, and some of the granite blocks are of enormous size. In the ground to the west of the Devil's Glen, blocks up to 150 tons in weight have been carried outward from the central ridge, five miles from the granite boundary. Even where the granite occupies very low ground, covered with shallow boulder-clay, the latter contains much granitic

material, illustrating how locally modified drift can accumulate in such situations.

In proximity to the high ground in many places, boulder-clay of the local character just described may be seen resting upon gravels, as in the section above shown (fig. 3); and stretching transgressively across the ends of tilted beds of sand, gravel, and shingle, which alternate with layers of boulder-clay, as may be seen at Killiney (see Plate II.).

The local drift of Kitestown valley at Howth, which may be considered a modified boulder-clay, extends to Balscadden Bay, where it overlies but merges with the sand and gravelly drift there embanked against the cliff.



FIG. 4.—Sketch taken 250 yards south of exit of Loughlinstown River on the shore; boulder, 3 feet 6 inches in length, of purplish brown, partially laminated boulder-clay, embedded in red boulder-clay which is partially stratified. Geol. Surv. Mem. to Sheet 112 (1903), p. 106.

Such are the data upon the strength of which we are entitled to speak of an Upper Boulder-clay in this region; it usually presents a partially stratified appearance, and contains angular blocks of stone, which, as stated above in reference to the Wicklow drift near the mountains, are often of very large size.

Layers of boulder-clay alternating with gravel may be seen along the Killiney section, and in such relations as to render it exceedingly hazardous to say that the lowest

of these layers is technically Lower Boulder-clay. The deposit to which this term may most justly be applied is the purple variety seen in Kill-o'-the-Grange brick-clay pit, and possibly in some sections along the Dodder River. One reason for this belief is, that *boulders* of clay, in every way similar to the clay of Kill-o'-the-Grange, occur in the re-arranged red boulder-clay of the Killiney section.

Another reason has also been already noticed, viz., that while the purple clay rests upon the rock at Kill-o'-the-Grange, it has nowhere in this region been found resting upon boulder-clay of another kind—either the red re-arranged clay, or the grey boulder-clay derived from the limestone of the central plain.

The islets fringing the Dublin coast bear cappings of drift similar to that of the contiguous mainland, which testifies to the extent of the encroachment of the sea in post-glacial times.¹

Sand and Gravel.—Kilmashogue Mountain is fringed by these deposits on its north, west, and south flanks to an elevation of over 1300 feet ; and the deposits appear at many points southward along the range on its eastern side, often assuming important proportions, as in the Cookstown River valley about Enniskerry. They occur in three different classes, which have been distinguished on the published Drift Map of the Dublin area. These are :—

1. *Intercalated layers* of various thicknesses in, and in many instances dovetailing with, boulder-clay.—Such alternations may be observed in the Killiney cliff-section, in the banks of the Dodder and its tributaries, and along the streams which drain the slopes of the Dublin range. The sands and gravels in these cases are but well-washed representatives of the materials of the boulder-clay in the vicinity, the contained stones being of the same kinds in both, but more perfectly rounded in the gravels. The gravels, and especially the coarse sandy layers, contain shell-fragments similar to those found in the brown boulder-clay.

¹ Cf. H. J. Seymour and R. Ll. Praeger, on Lambay, *Irish Naturalist*, vol. xvi. (1907), p. 112.

2. *Sand and gravel, irregularly stratified* and disposed characteristically in mounds and ridges (*eskers*), some of which, however, scarcely form very distinct features. A striking esker is that which is traceable from the south side of the Dodder by Balrothery northward to Drimnagh, and thence, as discontinuous mounds, across the Liffey to the vicinity of Castleknock. It is known as the Green Hills esker, and is to be seen in some places resting upon limestone (fig. 5), in others, as, for example, one mile north of Green Hills, upon boulder-clay. There is no doubt that the accumulation was formed by a rapidly flowing stream partly in and partly under the melting ice-sheet, which hurried along the sand, gravel, and shingle of which the ridge is composed; and it is of interest to note that the direction of this glacial river bears no relation to the present drainage, and is indeed transverse to it.

A much less manifest ridge, formed of a great thickness of stratified well-washed and rounded gravel, shingle, and sand, is to be seen at Skerries railway-station on the Great Northern line, associated with great mounds of gravelly drift, already mentioned. This deposit consists of such well-washed materials that it has supplied large quantities for building purposes; and here, as in many places elsewhere in this region, the sand and gravel seem to pass into those of the class first mentioned, which tends to show that they were in part laid down concurrently with some of the intercalated



Fig. 5.—Diagrammatic section, east and west across the Green Hills esker, showing the boulder-clay and sand and gravel resting on glaciated Carboniferous limestone (Calp). Length about a quarter of a mile; greatest depth about 40 feet. (Geol. Surv. Memoir, Sheet 112, 1903, p. 99.)

layers of the supra-glacial fluvial deposits. In general, however, the two classes of deposits are quite distinct, and the deposits of class (1) are absent from the summits of the eskers.

3. *Late Glacial Flood Gravels.*—The latest stage of melting, during the disappearance of the general ice-sheet, has been marked by the promiscuous deposition of sand, gravel, and shingle here and there over the flat-lying drifts. The rushing waters proceeding from the ice that was melting further inland eroded the loose materials already deposited, in some cases cutting through them into the rock beneath, and distributed the coarser products upon flood-plains. The distribution is in many instances independent of, because prior to, the establishment of the present courses of drainage; in other cases, the flood-gravels occur as coarse delta-fans at the mouths of valleys that once carried voluminous streams.

4. *Modern River-Gravels.*—The streams and rivers draining the mountain-slopes have in flood-times become charged with material from the easily eroded drifts, and have been able to roll onward coarse gravel, shingle, and large stones, to distribute the finer matter as alluvium in the lower reaches, or even bear it out to sea, leaving the coarser material in quickly-raised flats, over which the still rapid flood-waters coursed. These deposits mark a later stage in the geological history of our region than the one last described, in which the glacial flood-gravels were deposited; and it is to be noted that, while the glacial floods were for the most part independent of the present drainage-courses, the deposits here described were laid down by representatives of the present streams, though flowing at higher levels.

These later flood-deposits then became trenched and eroded by the prolonged action of the streams and rivers, now lessened in volume and restricted to particular channels, and the gravel-deposits consequently have assumed a terraced form. This erosion has proceeded to such an extent as to leave the summits of some terraces 40 feet or more above the present stream, as in the case of terraces along the Liffey below the gorge at Chapelizod. In recent times the Liffey has eroded not only the

drifts, but also the underlying rock, where, temporarily missing its old course, it has formed a new one by notching the rock to some extent. A striking instance of this is to be seen at Palmerstown, where the river forms a gorge in the limestone; another instance may be seen in the notch formed by a stream beside the road three-quarters of a mile south-west by west from Loughlinstown.

Thick deposits are to be seen along the course of the Dodder and its tributaries at successive heights, which mark stages in the erosion of the present valley. The small Loughlinstown stream is interesting from the fact that between the village and the sea it exposes glacial gravels and their associated boulder-clay high up on its south bank; gravelly and shingly terraces of old river-deposition, with many angular blocks of granite, detached and washed down from the notch already mentioned three-quarters of a mile distant; in addition, terraces, slightly higher than the stream-level, which have yielded large quantities of material for building purposes; a deposit of glacial flood-gravels spreading out from the stream to join it at the bay-shore; and recent alluvium fringing the present course. All the above deposits may be observed within the short limits of a mile.

An exceptional river-flood, due to a rain-burst of some five inches in twenty-four hours, which inundated Little Bray in August, 1905, exposed a variety of drifts along the greatly eroded banks of the Cookstown River. This mountain-stream, swollen to the dimensions of an overwhelming torrent, not only re-arranged the previously formed river-deposits, but carried down much of the easily denuded gravels of Glencullen, and cut into the boulder-clay near Enniskerry (see fig. 6); it uprooted trees, and carried away roads and bridges, distributing the shingle and gravel, with other products of the general wreck, along its course. On subsiding it left a thoroughly remodelled bed. We are here afforded an apt picture of what has doubtless often taken place, illustrating the ability of even insignificant streams, when swollen, to form, remodel, and in parts demolish beds of the coarsest material.

Professor Cole informs me that in parts of Glencullen the river lowered its bed in its older alluvium by as much as 18 inches.

Moraines.—Deposits of this class, which mark the decline and recession of glaciers issuing from local snow-fields, are also to be met with in this region. In Glendalough, the Seven Churches and Round Tower stand upon a morainic deposit ; and at the head of Glencree, the two lakes, Upper and Lower Lough Bray, occupying the bottoms



FIG. 6.—Section, about 5 feet high, in contorted boulder-clay, east of Enniskerry. (From a photograph by H. J. Seymour.)

of circular combes or cirques, are margined on their eastern sides by well-defined moraines, which slope downward to the Glencree River. The terminal moraine of the upper cirque merges into the southern lateral moraine of the lower cirque ; and the steep ridge thus formed between the two lakes has preserved its shape admirably, and bears huge erratics on its crest. Though a delta is forming in the lower lake, the cirque behind maintains a bold vertical

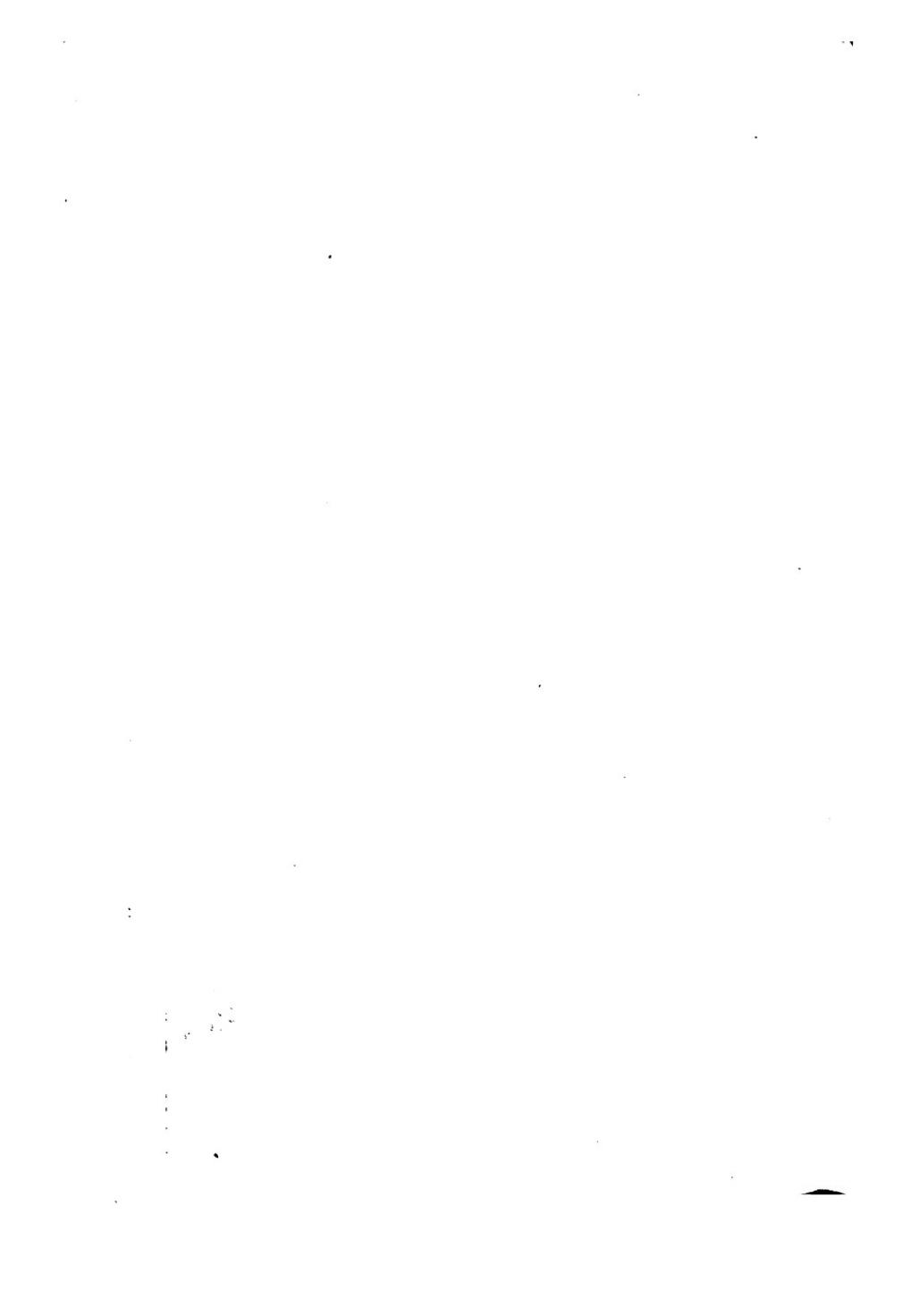


PLATE I.

[To face page 39.]



“DRY GAP” OF THE DINGLE, CARRICKMINES, CO. DUBLIN.
(From the Geological Survey Memoir on the country around Dublin.)

wall, its southern end projecting in the crag known as Eagle Rock.

Dry Gaps.—In connexion with the supra-glacial drainage, the remarkable features named *Dry Gaps* were formed.¹ These consist of steep-sided gorges, with a freshness of appearance suggestive of recent erosion, which, however, cannot reasonably be attributed to the comparatively insignificant streams, or mere boggy hollows, which they now carry. Their geographical position, moreover, is transverse or oblique to the direction of present drainage, and must therefore have been determined by conditions which no longer prevail. Thus, about a mile south-west of Rockbrook, the Killakee Valley, running northward, is connected with the Piperstown Valley, running north-westward, by a pass or gorge west-by-south, which trenches the intervening mountain-spur, severing Montpelier Hill (1271 feet) from the main group. The gorge is about 500 yards in length, 90 or 100 feet high, and 1085 feet above ordnance datum in its central portion, whence it throws off insignificant streams east and west. Other interesting examples are to be met with south of the road from Golden Ball to Carrickmines. This road runs along the foot of a spur, extending north-eastward from the mountain-group; and the spur is cut transversely by two gaps, the principal of which is the Dingle, the easterly member of the pair; the second runs parallel to it by Rockville. A view of the Dingle is shown in Plate I.; it is practically level throughout its length, though a small rivulet, issuing at its southern end, carries off the drainage which collects in swampy ground near the middle of the gorge. The grander and more familiar scenic feature, known as the Scalp, which traverses the Ballybetagh and Ballycorus spur almost at right angles, carrying the main road southward from Kilternan to Enniskerry, presents similar conditions on a much larger scale; and still further south the conditions are reproduced in the Glen of the

¹ Mem. Sheet 112 (1903), pp. 40, 50, 115, 116, 119, 123, 124. See also paper by W. B. Wright, Sci. Proc. Roy. Dub. Soc., vol. ix., 1902, pp. 575–582.

Downs near Delgany, which holds the same south-easterly direction as the Scalp. No trace of glaciation has been noticed on the walls of these gorges, though striæ have been found upon the summits of the spurs which they traverse ; and this observation, equally with the new or fresh appearance of the gaps, forbids the supposition that they are due to pre-glacial drainage, in their present form at least. The uniformity of condition, moreover, and the entire independence of the direction of the gap in each case, as compared with that of present drainage, point to their formation by torrential streams, controlled by the disposition of the ice in the glacial epoch. Such streams flowed either over ice which covered up the present contours, or from temporarily dammed-up bodies of water, maintained at the requisite level for a sufficient time by water from the melting ice. Mr. G. W. Lamplugh was the first to apply this explanation to features in the Dublin district. It is based on numerous observations in other areas, especially in North America.¹

ORIGIN OF THE GLACIAL DEPOSITS.

In the foregoing general description of the glacial and post-glacial deposits, it has been assumed that their existence is entirely attributable to land-ice ; that is to say, to the existence and melting of a slowly moving mass, of sufficient thickness and continuity, at one stage at least, to overtop the Dublin hills on the one hand, and to shut out ocean-waters from the Irish Sea on the other. The literature of the subject, however, indicates that this has not been a universally received hypothesis ; and an explanation of the present point of view is necessary.

The occurrence of marine shells in the drifts has naturally been suggestive of submergence, and the gravels

¹ Among recent papers on the subject may be cited Lamplugh, Handbook Liverpool Meeting Brit. Association (1896), p. 179 (Isle of Man); H. L. Fairchild, Geol. Mag., 1879, p. 529 (New York State); P. F. Kendall, Rep. Brit. Assoc., 1899, p. 743, and Quart. Journ. Geol. Soc., London, vol. lviii. (1902), p. 471 (Cleveland Hills); Dwerryhouse, *ibid.*, p. 572 (Teesdale and Tyndale); and Calhoun, "Montana Lobe of Keewatin Ice-sheet," Prof. Papers, U. S. Geol. Survey, 1906, p. 40, &c.

have been attributed to the melting of floating icebergs laden with detritus. The existence of stratified deposits amongst the drifts has been also cited in support. That this older hypothesis should be adequate, submergence to the extent of 1300 feet at least would be necessary for the laying down of the Kilmashogue gravels; while submergence to a much less extent—say 100 feet—would be required for the perfect washing, rounding, and stratification of the Killiney and other gravels and shingle, which alternate with layers of boulder-clay. It is difficult to think that water deep enough to float boulder-carrying icebergs could form the alternating layers of gravel and shingle.

The fragmentary condition of the marine shells has also led to much discussion. The earlier writers, Oldham, Scouler, Kelly, J. R. Kinahan, and the authors of the first edition of the Dublin Survey Memoir, all attributed the shell-bearing drifts to marine formation during submergence. Such a view was, indeed, in conformity with the prevalent opinion as to the general origin of drift through the agency of floating ice. M. H. Close, who, in 1864, attributed the glaciation of this region to a wide-spreading current of "glacier ice, which probably covered the greater part of the country, and hereabouts came from the north-west," concurred in regarding the shell-bearing drifts as having been carried thither by floating ice, although he recognized that the surfaces of the drifts at Ballyedmonduff (1000 feet) and at Caldbeck Castle (1200 feet) are not those of raised beaches, and that the marine fauna represented in the fragmentary shells did not live and die in the position in which it is now found.¹

Prof. Hull ascribed the deposits named by him the Middle Sands and Gravels, including those along the Killiney cliffs, to marine agencies, supposing the land to have been submerged; and Prof. Sollas, in 1893, while regarding the whole of Ireland to have been buried in a *mer de glace*, "with the exception of a few high

¹ Journ. Roy. Geol. Soc. Ireland, vol. iv., pp. 36–40, and Geol. Mag., dec. 2, vol. i, pp. 193–197.

peaks," admitted that it might still be necessary to regard submergence as the condition under which the shelly boulder-clay was deposited.¹ A similar view was maintained by Mr. T. Mellard Reade in the following year.²

A strong consensus of opinion, therefore, favoured the view of submergence, and this necessarily to the extent of some 1400 feet, notwithstanding the difficulties presented as sketched on p. 41. The late Professor Carvill Lewis, however, in 1886 expressed his belief,³ consistently maintained in 1894,⁴ that the Dublin shelly drifts, including the high-level gravels, could be regarded as morainic matter, originating in a great glacier from the north, which filled up the Irish Sea, and carried materials from its floor on to the land. Igneous rocks, flints, &c., from the counties of Antrim and Down had long been known to be abundant in these deposits. The discovery, first made by Prof. Cole, of Ailsa Craig rock in the Dublin drifts, is confirmatory of the conclusion that much of the material of the drifts—particularly the brown calcareous boulder-clay, as previously suggested—was borne southward.

The deposition of the drifts entirely from glacier-ice, as suggested by Carvill Lewis, is the standpoint from which they have been described in the Memoir accompanying the Drift-Map of the Dublin area ; and the reasons for adopting this view are ably summarized by Mr. G. W. Lamplugh on pp. 46 and 47 of the Memoir—a view in which the present writer concurs.

Briefly put, the reasons are as follows :—

1. Submergence would be certain to have left traces of a sea-margin, raised beaches, &c., were it sufficiently prolonged to admit of successive layers being deposited from icebergs ; but no such indications are noticeable around the Dublin hills.

¹ "The Geology of Dublin and its Neighbourhood," Proc. Geol. Assoc., vol. xiii., pp. 116-120.

² Proc. Liverpool Geol. Soc., vol. vii., pp. 183-206.

³ Rep. Brit. Assoc. for 1886, p. 632.

⁴ Glacial Geology of Great Britain and Ireland. London, 1894, pp. 145-153.

2. On the contrary, the gravels, with their stones in a well-washed and well-rounded condition, occur at many levels, sometimes intercalated with boulder-clays, and often without this covering. The shells contained in them are not only fragmentary, but occur in an utterly mixed manner as regards species and genera, and are nowhere seen in a position suggestive of their natural place of growth.

3. The drifts, both in character and arrangement, are entirely explicable on the hypothesis of land-ice. A thick covering of ice, which at one stage moved from the north-west, as will be shown, and at a previous stage probably moved from the north-east in the present region, yielded, on melting, alternating fluvio-glacial deposits—gravelly layers, and boulder-clays from mud-deluges—upon the much lowered surface of the ice, followed by the glacial flood-gravels spread out here and there from its receding margin.

It may be admitted that there was subsidence below sea-level prior to glacial times, but to what extent, and how long before, we cannot say. Possibly, such took place immediately prior to the glacial period, and continued for some time during it, the ocean-waters being subsequently excluded from this area by thick ice.

GLACIATION OF THE REGION.

The origin of the drifts being bound up with the glaciation of the region, reference to the latter may now be made. Numerous patches of striated rock have been met with throughout; and, as was long ago shown by Mr. Close, the striæ almost uniformly indicate a movement of land-ice from W.N.W. They are represented on the Drift-Map of Dublin at an elevation of 800 feet on the north slope of the Three-Rock Mountain, and near the summits of Howth and Killiney Hills, while they are to be seen at Portrane on a surface of Silurian grits about 15 to 20 feet above sea-level, pointing eastward.

The latter direction is significant in view of the fact that the hollow of the Irish Sea once carried an overwhelming glacier. It would seem to show that the striæ at Portrane indicate a stage of glaciation later than the existence of an

ice-obstruction in the Channel, and were formed during the latest stage of general glaciation from the west. The surface at Portrane is generally level, and not such as to constrain ice-movements in any special direction.

At Killiney Hill (512 feet), on the contrary, striæ, which may be traced from its northern base upward along the slope to the summit, show a distinct and gradual divergence towards the south from the prevailing direction. This divergence is as great as 40° at Mount Eagle, on the south side of the hill, and can only be attributable to pressure of ice from the channel, as the glacier which filled it expanded somewhat on reaching the sinus of Killiney Bay. These striæ, then, belong to a stage of the glacier's decline, preceding the stage of glaciation previously referred to in connexion with Portrane. Still earlier stages impressed their indications on the Dublin range; even if we attribute to ordinary weathering the rounded appearances which led Mr. Close to conjecture a stage at which the great ice-mass may have sent a stream right across the range, there is unquestionable evidence of those stages in rock-scorings on the north shoulder of Three-Rock Mountain at 800 feet elevation, boulder-clay at 1009 feet in Larch Hill valley, and gravels which were probably washed out of boulder-clay material at a still greater height—all indicative of early stages of glaciation—all indicative, too, of an ice-flow from the W.N.W. which carried the materials of a grey boulder-clay from the limestone region. Evidences of a gradual decline in the ice-mass may indeed be traced from the extreme in which it topped the Dublin mountains to that in which it slipped unobstructedly into the Irish Channel.

Referring now to the purple clay of Kill-o'-the-Grange and other points along the Dodder and margining the Wicklow coast, it appears to be of earlier deposition than the grey and red drifts, to some of which it furnished boulders of boulder-clay (pp. 84 and 47). This last fact suggests that, prior to re-arrangement, it must have been much more generally distributed, and that it supplied other contents to the later drifts, including stones and fragmentary shells, which could scarcely be supposed to have come in land-ice from the W.N.W.

The striated condition of some of the shell-fragments, as well as the fragmentary state of almost all of them, in the purple clay, as well as in the gravels, &c., proves that they must have been subjected to considerable pressure and differential movements in the containing ice-mass. The accumulation and movement of this clay in and under a great overwhelming glacier, as Carvill Lewis supposed, streaming down from Scotland, and carrying materials from the channel-floor to a considerable distance and height beyond the present Irish coast-line, and at a period antecedent to the ice-flow from the W.N.W., are consistent in every way with the phenomena described in the preceding paragraphs. Even the lack of striæ attributable to an ice-flow from the channel inwards, though unfortunate in some respects, is consistent with the abundance of evidence for the later flow; for by this, a former system of striæ, had it existed, would have been obliterated. A system indicating a westerly flow in Ulster was described many years ago by the present writer; and more recently additional proofs of this flow¹ were observed, south-west of Belfast, in the vicinity of Ballymena,² and in the north of Londonderry.³ It is probable, therefore, that the Irish Sea glacier, subject to pressure from accumulations in the Cumberland region at its maximum stage of development, invaded the Dublin region, pushing beneath it matter from the sea-floor, including some dropped in the channel from previously floating icebergs.

DETAILS OF DRIFT SECTIONS.

Kill-o'-the-Grange Clay.—The boulder-clay at Kill-o'-the-Grange seems to represent the oldest glacial deposit met with in the district. It is well exposed in the large brick-clay pits, half a mile west by south of Glenageary, and about two miles from the tram-line by Glenageary-road. The deposit is strongly calcareous, and remarkably homogeneous in character throughout, except where a

¹ Memoir accompanying Drift Map of Belfast area, p. 97.

² As lately observed by the writer.

³ Memoir accompanying Drift Map of Londonderry district, 1908.

lenticular band of gravel and shingle, with granite boulders, occurs near the top.

The mass, which totals about 40 feet in depth, rests upon granite, of which rock it contains a few boulders of large dimensions. It also contains, however, numerous stones of small size, chiefly pebbles of green grit, slate, limestone, basalt, chalk, and Cretaceous flints. A percentage list of kinds picked up at random has been given in an article by Professor Sollas and Mr. R. Ll. Praeger,¹ as follows :—

Carboniferous limestone,	.	.	38·2
Basalt,	.	.	15·8
Carboniferous sandstone,	.	.	15·0
Hard chalk,	.	.	5·9
Slate,	.	.	5·0
White quartzite,	.	.	3·8
Felstone,	.	.	3·8
Black flint,	.	.	2·5
Cambrian sandstone,	.	.	2·5
Cambrian slate,	.	.	1·6
Coal-measure shale,	.	.	1·6
Black micaceous grit,	.	.	1·6
Triassic sandstone,	.	.	·8
Epidiorite,	.	.	·8
Granite,	.	.	·8
Rhyolite,	.	.	·8
Lignite,	.	.	·8
White quartzite,	.	.	·8
			100·2

The occurrence here of Ailsa Craig rock (riebeckite-bearing granophyre) was also noted by these authors. A list of fossils was given, including several from the Upper, Middle, and Lower Lias, and some ostracods not named, a polyzoan, and foraminifera of several species.

A curious platy structure in the clay was noted by

¹ Irish Naturalist, vol. iv., pp. 321-328.



PLATE II.

[To face page 47.



GLACIAL SANDS AND GRAVELS, WITH BOULDER-CLAY BELOW, KILLINEY, CO. DUBLIN.
(From the Geological Survey Memoir on the country around Dublin.)

Professor Sollas, and described by him as "tea-leaf" structure, which may be accounted for by the pressure, accompanied by differential movement in the ground-moraine. This also accounts for the fragmentary condition of the shells contained in this boulder-clay.

Killiney Drifts. (Pl. II.).—At the Killiney end of the section are to be seen more or less regularly stratified layers of sand and gravel, dipping away from the hill at angles varying up to 40 degrees. In the middle portion of the section the gravels assume a boulder-clay appearance, resting upon boulder-clay, and pass laterally into a distinct boulder-clay. South of the point at which the Loughlinstown stream enters the bay, red and grey boulder-clay layers are intercalated in the gravels; such alternations continue for some distance, the gravels also in places passing into boulder-clay; and, at the last point where the section is clearly visible, they rest upon grey limestone boulder-clay, which some writers have taken to represent Lower Boulder-clay (see p. 88, *ante*). Some of the layers measure fifteen feet in thickness, and the one deemed to be the oldest deposit might, if evidence were available, prove to be a similar thick layer intercalated in the gravels.

Some three hundred yards south of the point at which the Loughlinstown stream enters the sea, the gravelly boulder-clay contains large irregular masses of purple clay (see figure 4, p. 88), with sharply defined outlines. Some of these are identical with the clay at Kill-o'-the-Grange, being highly calcareous, and in parts showing the same flaky structure. The surrounding drift is characteristically gravelly and reddish, in contrast to the colour of the included masses; and the existence of these masses testifies to the denudation of the purple boulder-clay, and the re-arrangement of its materials, as well as an intermingling with them of materials from other sources. Other masses¹ of irregular lenticular and trapezoidal shapes also occur in the gravelly drifts; they are not exactly of the purple clay type, being reddish, more gravelly, and non-calcareous, and may indicate an intermediate stage

¹ Noticed by Sollas and Praeger, *op. cit.*

of arrangement between the deposition of the Kill clay and the characteristically gravelly drift which now contains all these boulder-clay masses.

Further south than the point at which these masses occur, the gravelly drift containing them becomes a gravelly boulder-clay, which has been somewhat deeply eroded. The pockets due to erosion were, most probably, formed by glacial-flood action when the boulder-clay was in a frozen state, for their sides are in some cases vertical; they are filled with gravel and shingle, graduating upward into a layer of similar materials, which stretches over the adjoining boulder-clay and gravelly drift.

Numerous shell-fragments have been obtained from these Killiney drifts, similar to those of the Kill clay. Those identified will be found in a list given by the present writer in the *Irish Naturalist*, 1908.

Drift-Section at Howth.—A small area of drifts occurs at this village; and over Balscadden Bay they have a thickness of about 50 feet. They consist of boulder-clay at the bottom, upon which rest stratified shell-bearing sands and gravels; and these are in turn overlain by boulder-clay, which is continuous, as already stated, with the locally-formed drift of Kitestown valley. This upper boulder-clay shows slight traces of stratification, and is looser in texture than the boulder-clay beneath.

The gravels contain boulders of dimensions up to 2 feet by $1\frac{1}{2}$ feet by 1 foot, embedded in fine sand, the occurrence of which in such a deposit has been accounted for by the presence of icebergs in a temporary lake, formed in this region in glacial times, within frozen embankments. The gravels also contain numerous shell-fragments. Limestone pebbles predominate; but these drifts also contain pebbles of dolerite, epidiorite, grit, Old Red Sandstone, flint, chalk, and Ailsa Craig rock. Mr. Seymour also identified an iddingsite-basalt, such as that forming Craig Baron Hill, County Meath.¹

Similar shell-bearing gravels, with fragments of Ailsa Craig rock, are to be met with in a small pit close to the

¹ Mem. Sheet 112 (1903), p. 82.

rope-ferry, near Knockmaroon House, west of Phoenix Park; and the gravels are threaded with thin streaks of brown stony clay, which are suggestive of the source of the shells.

Dodder River Sections.—Many good sections of boulder-clay are to be seen along the Dodder River bank, as well as old river-gravel terraces. The boulder-clay consists chiefly of limestone detritus, forming a grey highly calcareous till, with scratched limestone blocks and pebbles, and occasional fragments of Silurian grit, Old Red Sandstone conglomerate, basic igneous rocks, including some of Lambay Porphyry type, hard chalk, and northern granites. It is noted, in the Dublin Memoir (p. 96), that "no boulders of granite of the Leinster types were noticed in the limestone-drift sections . . . between Oldbawn Bridge and the sea," although the granite region commences only about a mile to the south-east of Rathfarnham. East of Templeogue, erosion by the Dodder reveals the following section :—

	ft. in.
Alluvium with pebbly layers,	8 0
Coarse river-gravel with Leinster granite pebbles,	2 6
Limestone boulder-clay,	6 0
Calp limestone,	2 0

Brown Boulder-clay, Rathfarnham District.—In the river-section west of Rathfarnham, and that north-west of Butterfield House, brown clay similar to that at Kill-o'-the-Grange, and containing shell-fragments and far-travelled pebbles, is to be noticed, resting upon dark grey limestone boulder-clay. The order of superposition of these deposits has already been commented upon (see p. 34); but here it may be added that near Island Bridge brown clay is found to a depth of 4 feet, resting upon river-gravel and sand, where the former is obviously a post-glacial wash from neighbouring boulder-clay bluffs; so that it would be hazardous to base any conclusion upon the mere colour of the clay, though in this to some extent the clay corresponds with that at Kill-o'-the-Grange.

Brown clay was also noticed in a small valley leading from Newbawn to Woodfield, and, to the east of this, in the gully at Fairbank, 80 yards west of Millbrook. Shells were collected from this boulder-clay at two points, viz. :—

(a) From a section in the east branch of the Edmonds-town River, 500 to 600 yards south of Newtown Bridge.

(b) From a section in the banks of the Owendoher, Rathfarnham, behind the Yellow House. An important series of sections is to be noticed skirting the Three-Rock Mountain, commencing with those to be seen in Glenasmole.

Glenasmole.—The drifts of this valley consist of boulder-clay, and sands and gravels mainly derived from limestone, though the rock beneath is granite in the higher part of the

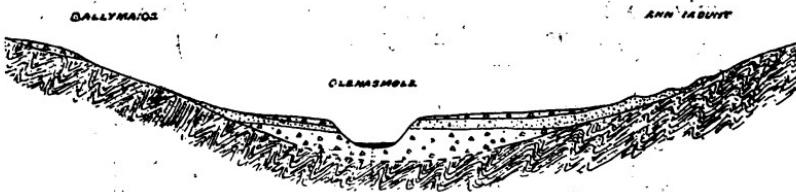


Fig. 7.—Diagram of Drifts in Glenasmole. Mem. Sheet 112 (1903), p. 126.

valley, and in the lower part Silurian grit and slate—micaschist margining the granite. Below the lower reservoir in the bottom of the glen is to be seen in the right bank, and under 30 feet of limestone boulder-clay, “a contorted mass of granitic sand, about 15 feet thick, containing pebbles of quartz, slate, and other local rocks . . . which appeared to be the remnant of a deposit of local origin earlier than the limestone-drift.”¹

The above diagram illustrates the arrangement of drifts in the glen, with sand and gravel between boulder-clays.

Fragments of hard-chalk and flint from Antrim occur in

¹ Mem. Sheet 112 (1903), p. 124.

these gravels, and, as stated in the Memoir, "shell-fragments also occur . . . as is almost invariably the case where these pebbles from the north-eastward are found in the drifts." Dr. J. Scouler, as long ago as 1888, reported the presence of shell-fragments, and in 1854 Mr. J. Kelly recorded *Turritella terebra* and *Mactra*(?) from Corrageen on the eastern side of the glen.

Lower down the valley, at Bohernabreena chapel, limestone boulder-clay and gravels occur—some of the latter, with sands and silts, forming curiously contorted bands in the boulder-clay. The gravels of this locality yielded to Dr. J. R. Kinahan¹ several species of shells.

Larch Hill Valley, south of Rathfarnham.—Sections of boulder-clay over 12 feet in depth have been exposed in the higher portions of this valley along the banks of the stream draining it. It consists of tough blue clay with striated boulders and pebbles of limestone, and is overlain with débris from the granite above. At Larch Hill a large pit has been opened in limestone gravels with numerous granite pebbles. These gravels have yielded a great abundance of shell-fragments, many in a good state of preservation. Forty-two recognizable species were obtained by Mr. Hinch from this pit alone.

Half a mile to the south-west of this point on the Tibbradden mountain-spur, beside the Glendoo road, a section of stratified gravel and silt is revealed, in which Mr. Hinch found shells.

The same observer has more recently noted another site of shell-bearing gravel, near the boundary of Killakee and Montpelier, near to where the Glencree and Cruagh roads meet, at 1250 feet elevation (see Irish Naturalist for 1908).

Ticknock Valley.—On the eastern side of Kilmashogue Mountain, the Little Dargle River cuts its way through limestone boulder-clay and thick deposits of gravel. Several pits opened here reveal sections 15 feet in depth. Ailsa Craig rock-fragments have also been found. The uppermost portions of the gravels are studded with granite

¹ Journ. Geol. Soc. Dub., vol. vii. (1858), p. 87.

boulders and weathered shale fragments, and in places become a local boulder-clay. The gravels overlain by them rest in turn upon limestone boulder-clay, giving the same apparent three-fold division of the drifts as is to be seen at Howth.

Caldbeck Castle.—Westward of the Three-Rocks, on the col above Ticknock, which connects Kilmashogue Mountain with the main mass, stands Caldbeck Castle; about a furlong south of this ruin a pit was opened in clean gravel and sand, at an elevation of over 1200 feet, from which the late Mr. M. H. Close obtained six species of shells.

Ballyedmonduff Drift.—This locality lies on the east side of Three-Rock Mountain. Here shell-bearing gravels yielded to Mr. M. H. Close his most important collection of drift-shells, which were described by him, with those found at Caldbeck Castle, in the papers mentioned on p. 28. The shell-bearing deposit occurs 1000 feet above the sea, just opposite Ballyedmonduff House, near the road leading from Stepaside to Glencullen, and on its east side. The site is now much covered by grass. The shells were named by the late Mr. W. H. Baily and Dr. Carte.¹ The gravels extend over the col, where large fresh pits occur, and where they are overlain at an elevation of 1050 feet by some boulder-clay.

Glencullen.—In the valley of the Cookstown River, between Enniskerry and Glencullen Bridge, the gravels are again encountered, presenting imposing sections in the banks of this mountain-stream. Scratched blocks of limestone abound, and minute shell-fragments may easily be detected. Large boulders of the local granite occur in the upper layers, and were possibly floated down a flood-stream on ice-rafts from the hills during the last stage of glaciation. Prof. Cole² has referred to this deposit as presenting “the finest section of these sands and gravels, probably one of the grandest in the British Isles.”

¹ Journ. Roy. Geol. Soc. I., vol. iv., pp. 36-40; and Geol. Mag., 1874, pp. 193-197.

² Irish Naturalist, vol. i., p. 92, and frontispiece.

RECENT OSCILLATIONS OF SURFACE LEVEL.

Judging from the depth to which the Dublin and Wicklow rivers have eroded their beds at their mouths, it would appear that in post-glacial times the land stood at a higher level than it now does. On the other hand, there is clear evidence for a depression of the coast some ten or twelve feet below its present level. Thus, within the present shore-line of Dublin Bay an older shore-line is traceable, where the boulder-clay was denuded by wave-erosion. The bay in consequence extended at one time further inland. About that period the shingle and coarse gravel carried down by the Liffey, Tolka, and Dodder were deposited in a great delta-fan, which stretches from Annesley Bridge at Fairview to Merrion, south of the city; a bank was formed which now connects Howth, then an island, with the mainland; and a rock-platform was either formed, or stripped clear of drifts, which may be noticed at a few points along the coast.¹ Subsequent elevation revealed these features, and formed the present suburban building areas of Pembroke Township and Sutton.

That Ireland stood considerably higher than it does at present within recent times has been proved by the discovery of submerged layers of peat at many points around the coast;² and the same fact is attested by the occurrence of a peaty layer with rooted tree-stumps beneath marine clay at Bray Harbour, as shown by Mr. Praeger.³

The peat crops out, above low water, north of Bray harbour, and is full of branches, roots, and cones of Scotch Fir; and it dips southward under the marine clay. "The clay is extremely fine and tough, and is full of *Scrobicularia piperata*." With it occurs *Tellina balthica*; and a specimen of *Littorina littorea* was also found. The

¹ The existence of a *pre-glacial* platform has yet to be proved in this locality, corresponding with that discovered by Messrs. W. B. Wright and H. B. Muff in Cork. *Sci. Proc. Roy. Dub. Soc.*, vol. x. pt. ii. (1904), pp. 250-324.

² See Memoir accompanying Drift Map of Cork, pp. 74-76.

³ "A Submerged Pine-Forest." *Irish Naturalist*, vol. v. (1896), p. 155.

evidence near Bray proves, then, the submergence of a forest, growing on a drift-surface, to such a depth as to allow of the formation of the blue marine clay above it; and subsequent elevation, which has brought the forest up to the present level of low water.

MINERALOGY.

By H. J. SEYMOUR, B.A., F.G.S.

THE area dealt with in the following notes has probably received more attention at the hands of mineralogists than any other portion of Ireland, with the possible exception of Co. Donegal. This attention, while in some degree due to the ground being within easy access of the metropolis, is, doubtless, mainly attributable to the occurrence within the area of very varied types of rocks, furnishing suitable habitats for very different mineral associations. Considerable stimulus was, moreover, given to the study of mineralogy in Dublin by the purchase of the great Leske collection of minerals by the Royal Dublin Society in 1792.

In addition to various classes of sedimentary rocks belonging to several periods, there are also three or four distinct types of igneous rocks near Dublin, chief amongst them being the Leinster granite, the northern portion of this *massif* traversing the greater part of the district under notice. Where the granite comes in contact with the Silurian sediments through which it has been intruded, extensive alteration has been effected in the latter, resulting in the formation of secondary anhydrous minerals. It is also chiefly in the vicinity of the same junction that the mineral lodes have been developed, which were once so extensively mined in the counties of Dublin and Wicklow; while it may be also suggested that the granite has played some part in the formation of the mineral veins further south, associated with the felsites and andesites of the Silurian rocks of the Ovoca valley and neighbourhood.

In the Annals of the Four Masters, written in 1682,

mention is made of the occurrence of *gold* in the present district; but it was not till Weaver's (1) time that any systematic examination of the minerals occurring in it was carried out. His observations, made during the period when the Gold Mines Valley was being worked for the precious metal, were subsequently amplified and confirmed by Mallet (2) in 1850.

From the researches of various workers, it is quite clear that gold is rather widely distributed in the counties of Dublin and Wicklow. A few years ago the writer found that the black sands obtained from the seashore opposite the Bray Esplanade contained a considerable number of gold specks, just visible to the unaided eye; while a sample of similar sand from Arklow Head was still richer in this metal. Up to the present, however, the matrix from which the alluvial gold has been derived has not been very satisfactorily determined.

The late Professor O'Reilly (3) made numerous assays of rocks in the neighbourhood of Dublin, but only in one instance was as much as two pennyweights per ton detected. Since then Mr. Lyburn (4) has assayed a number of specimens from Co. Wicklow, in the vicinity of Croghan Kinsheala, chiefly with negative results; but one ferruginous quartz vein, some eight inches wide, yielded four pennyweights to the ton. This result is the highest that has ever been obtained from any gold-bearing rock in Ireland; and, taken in conjunction with the proved auriferous nature of a quartz vein in Bray Head, mentioned by Kinahan (5), seems to point to this class of rock as being the original matrix of the alluvial gold found in the district. A full account of the gold nuggets found in Wicklow has been published by the late Dr. V. Ball (6), and specimens and models may be seen in the collection of Irish minerals in the Museum of Science and Art; while the economic side of the question has been dealt with by Messrs. G. H. Kinahan (7) and Gerrard A. Kinahan (5). That a great deal of alluvial gold occurs in Co. Wicklow is testified by the fact that down to the present day numerous small nuggets, up to a quarter of an inch long, are being washed out of the various rivers by amateur prospectors,

with primitive appliances, who apparently find the search a paying proposition. The suggestion made long ago by Mr. G. H. Kinahan (7), and since confirmed by other geologists, that the higher terrace-gravels of the Gold Mines Valley and the deeper "placer" gravels should be examined for gold, is well worthy of attention, a necessary preliminary being the detailed mapping of these deposits, which could probably be done with the aid of the Geological Survey.

In the lead ore at Ballycorus, as in most argentiferous galenas, *silver* in the native condition was obtained, and has been recorded by Dr. Haughton (8) amongst others. Associated with the *galena* in the ore-veins of this district is usually *zinc-blende*, some fine translucent crystals having been formerly obtained from the Clontarf mine on the north of Dublin Bay. The same ores occur in the metamorphosed Silurian rocks north and west of Glendalough, and also at Glenmalure, the associated minerals in this region including *cerussite*, *anglesite*, *pyromorphite*, *fluor-spar*, *barytes*, and *harmotome*; the last-named occurs on quartz from the Luganure mine. All these minerals are recorded in Giesecke's (9) catalogue of 1892, and the harmotome has been described in detail by Dr. Joly (10).

Last year Mr. Arthur Russell (12) published the finds made by him in 1904 and 1906 of the minerals *linarite* and *caledonite*, which were not previously known to occur in Ireland. They were found in ore-material from the Glendasan and Glenmalure mines near Glendalough. Mr. Russell also mentions the probable occurrence of a third species new to Ireland, viz., *aurichalcite*.

One of the most interesting finds made in this area in recent times was the discovery of the minerals *anatase* and *brookite*, by Professor O'Reilly (13), in 1898. They were obtained as minute crystals in the residue left after "panning" a decomposed yellowish clay that filled a joint in the Cambrian quartzites of Carrickgollogan, near Shankill, which so far is the only Irish locality for these minerals. The same observer was the first to recognize that the chief potash-bearing felspar of the Dublin granite was really *microcline* (14), and not orthoclase, as had hitherto

been supposed. The other felspars in the Leinster granite are *albite*, first recognized in 1868 by Westropp (15) and Haughton (16), and *oligooclase*, recognized by Sollas (17). The last authority has also shown that the essential dark mica of the granite is *haughtonite* (17), and not lepidomelane, inasmuch as the contained iron in the former mineral is in the ferrous condition, replacing magnesia, and not, as in the latter species, in the ferric condition, replacing alumina.

Beryl is one of the more common "accidental" minerals in the granite, some of the best specimens occurring at Glencullen, where Dr. Joly (11) has described their characteristics in detail, as well as those of the associated *iolite*.

The most interesting metallic ore hitherto got in the granite is *cassiterite*, small crystals of which were found in the Dalkey quarries by Dr. Taylor, and recorded by Sir R. Griffith (19). This is one of the only two localities in Ireland where cassiterite has been obtained *in situ*, the other being in the Mourne Mountains, as recorded by the present writer (18). Dr. Joly has also obtained some crystals of this mineral in a boulder of granite from the boulder-clay at Greystones.

The anhydrous silicates occurring in the metamorphosed Silurian rocks are not of any special interest. *Andalusite* and *garnet* are common, and the former occasionally shows *chiastolite*-structure. *Staurolite* is rare, but has been found near the Luganure mines in Co. Wicklow. The most interesting and uncommon of the minerals occurring in the Carboniferous limestone is *strontianite*. This mineral, which also occurs at Glendalough (in schist), was formerly obtained from the calp-limestone quarries near Golden Bridge, west of Dublin.

Barytes formed much of the vein-stuff at the old mine of Ballycorus, and occurs frequently as veins in the Silurian strata of Portrane. A vein of the same mineral, some six to eight inches thick, occurs also in the Carboniferous limestone, about two miles N. by W. of Finglas, Co. Dublin.

The following is believed to be a complete list of the

distinct mineral species known to occur in the district under review, the total number being 58 :—

albite,	chalcopyrite,	manganite,
anatase,	chiastolite,	microcline,
andalusite,	chlorite,	minium,
andesine,	corundum,	mispickel,
anglesite,	dolomite,	muscovite,
apatite,	epidote,	oligoclase,
augite,	epsomite,	orthite,
aurichalcite,	fluor-spar,	orthoclase,
barytes,	galena,	pyrite,
beryl,	garnet,	pyromorphite,
biotite (haugh-tonite),	gold,	quartz,
blende,	harmotome,	rutile,
brookite,	hematite,	sphene,
calcite,	hornblende,	spodumene (and “killinite”)
aledonite,	hyalite,	staurolite,
cassiterite,	iolite,	steatite,
celestine,	labradorite,	strontianite,
cerussite,	limonite,	tourmaline,
chalcocite,	linarite,	
	magnetite,	zircon.

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METEOROLOGY.

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INTRODUCTION.

DUBLIN stands at the extreme western end of the beautiful Bay of Dublin, close to the mouth of the River Anna Liffey, along both north and south banks of which the city extends for a distance of some two miles. It is 292 miles in a direct line W.N.W. of London, 188 miles west of Liverpool, and 69 miles west of Holyhead, and is situated in latitude $53^{\circ} 20' N.$, longitude $6^{\circ} 17' W.$ It comprises an area within the municipal boundary of 7,911 acres, containing, in 1901, 92,061 inhabited houses, and a population of 290,638. But these figures by no means represent what may be called "Greater Dublin," or the Dublin Registration District. This consists not only of the city proper, but also of the populous suburban districts of Rathmines, Pembroke, Blackrock, and Kingstown. The population of this "Greater Dublin" was, in 1901, 375,076; and its extent is 24,693 statute acres. In 1908 the estimated population of the Dublin Registration District is 894,525, while that of the City proper is 803,874.

The dark peat-stained waters of the Anna Liffey gave its present name to the Irish capital, for the Celtic *Duibhlinn* signifies "black pool." The site of the city at the old "ford of the hurdles" was originally not only beside a pool of dark water (*Duibhlinn*) but in a swamp, for the prefix "Anna" in the name *Anna Liffey* signifies literally a watery place, a marsh or swamp, *annagh* (*eanach*) being derived from *ean*, water. A considerable portion of the city is built on a pervious stratum of soil, consisting of a sand and gravel bed formed by an old raised sea-beach, which occupies the centre of the city along both sides of the River Liffey (p. 58).

The system of main-drainage, opened in September,

1906, will, in time, lead to the purification of the River Liffey, and to an effective draining and cleansing of the gravel bed, with, no doubt, a highly beneficial effect upon the health of the city.

The principal thoroughfares of Dublin are broad and straight, with the exception of Grafton Street, which is far too narrow for the great stream of life and bustle which flows through it for many hours of each working day. The city is well supplied with "lungs" in the splendid squares on both north and south sides of the intersecting river. One of the largest of these open spaces is due to the University of Dublin, with its quadrangles and far-stretching gardens and College Park. Another is St. Stephen's Green, made free to the citizens in 1880 by the munificence of the Right Hon. the Lord Ardilaun.

The grave defect which does much to neutralize the beneficial effect of the situation and surroundings of the capital upon public health is the housing of the poorer classes. Much has been done, however, of late years to abate the crying evil of the Dublin tenement-houses, and a further movement is on foot at present to provide sanitary accommodation on very reasonable terms for even the very poor among the industrious and sober classes of the population.

CLIMATE.

The climate of Dublin is, in the fullest sense, an *insular* one, free from extremes of heat and cold—except on very rare occasions—and characterized by a moderate rainfall (about 28 inches) annually, which is distributed, however, over a large number of days (about 198 in each year). Clouded skies, a high degree of humidity, and prevalence of brisk winds—chiefly from westerly points of the compass—make up the climatology of the Irish capital.

In common with the rest of the British Islands, Dublin owes its mild, equable climate in great measure to the proximity of the North Atlantic Ocean and its north-easterly surface-current of warm water.

Another obvious cause of the mildness of the climate is

the overwhelming prevalence of south-westerly and westerly winds, which are both warm and moist. These winds have been shown to form part of a cyclonic circulation round a large area of low atmospheric pressure, the centre of which in winter lies not far from Iceland over the North Atlantic. Only in spring do these periodic winds give place to northerly and easterly breezes.

But local natural advantages, as regards situation, exercise a further beneficial effect on the climate of Dublin. A few miles south of the city lies a range of mountains, with summits varying in height from 1000 to more than 2500 feet. This mountain-chain intercepts the vapour-laden winds at all points between S.S.E. and S.W., and so the rainfall is diminished and the sky is comparatively cleared during the continuance of the southerly and south-westerly winds which so frequently prevail. The absence of any very high ground to the northward of the city—with the exception of the Hill of Howth, which rises, however, only to 568 feet—also prevents excessive precipitation with south-west winds. It is true that with south-east to north-east or north winds the precipitation (often in the form of hail, and in winter of sleet or snow) in and about Dublin exceeds that which occurs at such a time inland or on the Atlantic coasts. Were it not for this “lee-shore” condensation, the Dublin rainfall would be considerably smaller even than it is.

The second local feature which ameliorates the climate of the capital is the proximity of the sea to the eastward of the city. The keen, dry, searching, easterly winds of winter and spring are much softened in their passage across the Irish Sea, so that during their prevalence the thermometer occasionally stands some 5° or upwards higher in Dublin than it does at Holyhead, although this latter place is actually on the sea. It is true that the converse holds good during westerly and north-westerly winds, when severe frost sometimes occurs in winter in Dublin, while the thermometer remains decidedly above the freezing-point at Holyhead. Yet these latter winds are never so piercingly cold and parching as those from easterly points. Nor is it in winter merely that the Irish Sea confers a benefit upon

Dublin. In calm, clear weather in summer time, no sooner has the sun mounted high in the heavens than a cool, refreshing sea-breeze—a typical “inbat,”¹ as the modern Greeks call it—sets in towards the land, so that consequently extreme or oppressive heat is rarely experienced. Indeed, an oppressive atmosphere happens only when a damp, warm south-west wind is blowing, with a more or less clouded sky. Temperatures above 80° in the screen in Dublin nearly always coincide with winds off the land, from some point between south and west, and a clear or only lightly clouded sky.

Among climatic epiphenomena, the infrequency of thunder-storms and the relative frequency of hail-showers in Dublin are worthy of note. In winter, fog and frost often prevail in the city, when a northerly breeze is blowing along the coast, accompanied with a higher temperature, and perhaps showers of rain. Lastly, in summer, with a westerly wind, heavy planetary showers fall at times in the valley of the Liffey, while the neighbouring higher lands enjoy dry weather.

The following averages of temperature, rainfall, and bright sunshine are based on observations taken during 1871–1905 at three Normal Climatological Stations in or near the Irish metropolis. They are culled from Appendix III. of the Weekly Weather Report, 1906, published by the Meteorological Office, London.

¹ Evidently a derivative from *έμβαίνω*.

TEMPERATURE.

	Dublin City (Fitzwilliam Sq.).			Royal Botanic Gardens (Glasnevin).			Ordnance Survey (Phoenix Park).		
	Mean max.	Mean min.	Mean	Mean max.	Mean min.	Mean	Mean max.	Mean min.	Mean
January, .	46·0	37·4	41·7	45·8	35·2	40·5	45·5	34·7	40·1
February, .	46·9	37·9	42·4	47·1	35·3	41·2	46·5	34·7	40·6
March, .	49·2	38·2	43·7	49·3	35·6	42·4	48·7	35·0	41·9
April, .	53·6	41·5	47·6	53·5	38·4	46·0	52·8	37·8	45·3
May, .	58·8	45·5	52·2	58·2	41·9	50·1	57·7	41·3	49·5
June, .	64·5	51·3	57·9	64·5	47·9	56·2	63·9	47·1	55·5
July, .	66·8	54·2	60·5	67·0	51·3	59·2	66·1	50·6	58·4
August, .	65·7	53·6	59·7	66·2	50·7	58·5	65·4	50·1	57·7
September, .	61·7	50·2	55·9	62·4	47·0	54·7	61·6	46·3	54·0
October, .	54·7	44·3	49·5	55·2	41·4	48·3	54·5	41·1	47·8
November, .	49·9	40·8	45·3	50·0	38·2	44·1	49·6	37·7	43·7
December, .	46·3	37·6	42·0	46·0	35·0	40·5	45·8	34·6	40·2
Whole year,	55·3	44·4	49·9	55·4	41·5	48·5	54·8	40·9	47·9

The respective heights of the three stations above mean sea-level are—Fitzwilliam Square, 47 feet; Glasnevin, 67 feet; Phoenix Park, 155 feet.

RAINFALL AND RAIN-DAYS.

Month.	Dublin City (Fitzwilliam Square).		Royal Botanic Gardens (Glasnevin). (1875-1905).		Ordnance Survey (Phoenix Park).	
	Rainfall in inches.	Rain- Days.	Rainfall in inches.	Rain- Days.	Rainfall in inches.	Rain Days.
January, .	2·21	18	2·28	15	2·24	20
February, .	2·01	15	1·99	14	1·89	17
March, .	1·91	17	2·05	14	2·03	19
April, .	1·94	16	1·94	14	1·84	17
May, .	1·97	15	2·01	13	1·99	16
June, .	1·99	15	2·08	13	2·08	15
July, .	2·68	17	2·75	16	2·84	19
August, .	3·24	18	3·45	17	3·32	19
September, .	2·21	15	2·33	13	2·22	16
October, .	2·87	18	2·86	16	2·85	19
November, .	2·72	17	2·78	15	2·87	19
December, .	2·25	17	2·29	16	2·35	19
TOTALS, .	28·00	198	28·81	176	28·52	215

The rainfall in 1887 was very exceptionally small—16·601 inches—the only approach to this measurement in Dublin being in 1870, when only 20·859 inches fell; in 1884, when the measurement was 20·467 inches; and in 1883, with its rainfall of 20·498 inches.

The scanty rainfall in 1887 was in marked contrast to the abundant downpour in 1886, when 32·966 inches—or as nearly as possible double the fall of 1887—fell on 220 days. In 1900 the rainfall was 34·338 inches, or 6·338 inches in excess of the average for the 35 years 1871–1905. Only twice since these records commenced has the rainfall in Dublin exceeded that of 1900—namely, in 1872, when 35·566 inches fell on 238 days, and in 1880, when 34·512 inches were measured on, however, only 188 days.

In 1905 the rainfall in 24 hours, from 9 a.m. to 9 a.m., on only one occasion exceeded 1 inch—namely, on August 25th, but it then amounted to 3·486 inches, the greatest daily fall registered in Dublin (Fitzwilliam Square) since these records began.

February, 1891, was the driest month on record in Dublin. There were only two rain-days during the whole month; and the rainfall was but .042 inch. September, 1865, also, had only three rain-days, with a rainfall of only .056 inch. The mean temperature of the latter month was 61·4°, or 5·5° above the average (55·9°) for September.

On the other hand, December, 1876, had a rainfall of 7·566 inches on 22 days. In October, 1880, also, 7·358 inches of rain fell on, however, but 15 days—the precipitation on the 27th alone was nearly 2 $\frac{1}{4}$ inches (2·736). In July of the same year, 6·087 inches of rain fell on 24 days. In August, 1905, the rainfall amounted to 7·019 inches on 22 days; but nearly half of this large precipitation occurred on the 25th, when the measurement was 3·486 inches. Even higher records were made among the mountains south of the city, and the flood-waters resulting from the torrential fall cut away roads, and inundated the village of Little Bray. In November, 1888, the rainfall was 6·549 inches on 26 days. The wettest month—that is, the month in which there were most rain-

days—was October, 1907, during which 5·121 inches fell on as many as 29 days. In July, 1871, 4·391 inches fell on no less than 28 days.

The excessive rainfall on August 25th, 1905, is specially noteworthy. It was the ninth occasion only since 1865—that is, in 42 years—upon which 2 inches have been measured in Dublin at 9 a.m. as the product of the preceding 24 hours' precipitation. The previous excessive falls were—August 18th, 1874 (2·482 inches); October 27th, 1880 (2·786 inches); May 28th, 1892, 2·056 inches; July 24th, 1896, 2·020 inches; August 5th, 1899 (2·227 inches); August 2nd, 1900 (2·185 inches); November 11th, 1901 (2·087 inches); and September 2nd, 1902 (2·075 inches). On no previous occasion within the past 42 years had 3 inches or upwards been measured.

The comparatively small precipitation in and near Dublin clearly depends on the geographical surroundings of the Irish capital—its situation in the east of the island, and the grouping of high lands to the south-east, south, and south-west, whereby the rain-bearing winds are drained of their superabundant moisture before they reach the valley of the Liffey and the plains lying north of that river.

BRIGHT SUNSHINE recorded at the Ordnance Survey Office,
Phoenix Park, during the 25 years 1881-1905.

		Duration in hours.	Per cent.
January,	..	58	24
February,	..	71	26
March,	..	124	34
April,	..	162	39
May,	..	212	44
June,	..	196	39
July,	..	169	33
August,	..	164	36
September,	..	143	38
October,	..	109	34
November,	..	70	28
December,	..	52	23
Annual,	..	1530	35

Extreme Temperatures.—Since January, 1868, the extreme readings of the thermometer in Stevenson's stand recorded at Fitzwilliam Square, Dublin, have been $87\cdot2^{\circ}$ on July 15, 1878, and $19\cdot8^{\circ}$ on December 14, 1882—a range of $78\cdot9^{\circ}$ Fahr. But these values are very exceptional. The average annual range of mean temperature is not quite 19° —viz., January, $41\cdot7^{\circ}$; July, $60\cdot5^{\circ}$ —that is, $18\cdot8^{\circ}$ F.

RELATIVE HUMIDITY.

By this term is meant the percentage of saturation of the atmosphere with aqueous vapour. The relative humidity of absolutely dry air is 0, that of saturated air, when dew is deposited or fog forms, is 100. In Dublin the *mean relative humidity* in the 80 years 1871–1900, was 82·6 per cent. (81·4 per cent. at 9 a.m. and 83·8 per cent. at 9 p.m.). It is highest on an average in December (86·5 per cent.) and lowest in May (76·5 per cent.)—this latter being the month when temperature is rising most quickly, and when, therefore, the capacity of the air for aqueous vapour is at a maximum.

MEAN ATMOSPHERIC PRESSURE.

The mean monthly and yearly atmospheric pressure, reduced to 32° and mean sea-level, in the city of Dublin (40 Fitzwilliam Square, W.), during the 80 years 1871 to 1900, inclusive, was—

	Inches.		Inches.
January .	29.901	July .	29.916
February .	29.902	August .	29.894
March .	29.891	September .	29.931
April .	29.874	October .	29.859
May .	29.956	November .	29.856
June .	29.956	December .	29.856

Annual Mean = 29.899 inches.

From this Table it appears that the monthly mean pressure rises to 29.956 inches in May and June, and falls to 29.856 inches in November and December. The absolute extreme readings of the barometer at any time taken

at Fitzwilliam Square were—maximum, 31.020 inches, at 10 a.m. of January 9, 1896; minimum, 27.758 inches at 2.30 p.m. of December 8, 1886. These readings assuredly represent the extreme range of atmospheric pressure, reduced to sea-level, in Dublin—namely, 8.262 inches, rather more than 3½ inches.

AMOUNT OF CLOUD.

This climatological element varied in the 80 years, 1871–1900, from 63.7 per cent. at 9 a.m. to 55.5 per cent. at 9 p.m., the mean being 59.5 per cent. February is the most cloudy month (65 per cent.). May is the least so (55 per cent.). The clearness of the sky at 9 p.m. in May is a striking characteristic of the meteorology of that month.

WEATHER AND RAINFALL IN 1907.

The following Tables contain the results of observations taken at Fitzwilliam Square, Dublin, in 1907:—

Rain-Gauge:—Diameter of Funnel, 8 in. Height of top—above ground, 1 ft. 4 in.; above sea-level, 50 ft.

Month.	Total Depth.	Greatest Fall in 24 hours.		Number of days on which 'or or more fell.
		Inches	Inches	
January,	.428	.188	1st	9
February,	1.304	.379	11th	14
March,	1.934	.742	19th	19
April,	2.622	.380	2nd	22
May,	3.211	1.115 ¹	6th	17
June,	2.837	.498	4th	27
July,	2.022	.460	3rd	19
August,	2.230	.498	29th	19
September,	.552	.260	3rd	7
October,	5.121	.711	8th	29
November,	2.584	.528	26th	14
December,	2.149	.490	19th	22
Total,	26.994	1.115 ¹	May 6th	218

¹ Maximum.

**ABSTRACT OF METEOROLOGICAL OBSERVATIONS TAKEN AT DUBLIN (40 FITZWILLIAM SQUARE, WEST)
DURING THE YEAR 1907.**

Meteorology.

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Month	Abs. Max.	Date.	Abs. Min.	Mean Daily Max.	Mean Daily Min.	Rain- fall.	Mean Height of Baro- meter.	Highest Pressure.	Date.	Lowest Pressure.	Date.	Prevalent Winds.	
January,	54.1	1st	27°.5	26th	47°.2	38°.1	.428	9	30°.303	30°.926	23rd	28°.968	1st W., S.W.
February,	55.7	15th	28.4	5th	45.5	35.1	1.304	14	30.002	30.572	5th	28.907	12th W., N.W.
March,	64.1	27th	31.8	31st	53.4	39.6	1.934	19	30.107	30.482	23rd	28.794	16th S.W., N.W., N.W.
April,	67.0	25th	33.2	15th	53.8	40.5	2.622	22	29.767	30.357	25th	29.113	3rd N.W., W.
May,	67.5	21th	34.4	1st	58.0	44.7	3.211	17	29.813	30.334	17th	29.130	2nd N.E., E.
June,	65.2	14th	43.0	25th	61.7	49.0	2.837	27	29.761	30.232	16th	29.399	10th W., S.W., N.W.
July,	77.3	17th	43.8	11th	65.6	53.5	2.022	19	30.014	30.507	11th	29.450	3rd W., N.W., S.W.
August,	73.1	13th	44.1	30th	64.9	52.7	2.230	19	29.927	30.383	21st	29.517	4th W., S.W., N.W.
September,	71.2	10th	38.7	4th	63.4	52.2	.652	7	30.091	30.472	18th	29.486	2nd N.E., E., S.E., W.
October,	65.1	5th	32.8	24th	54.5	45.3	5.121	29	29.561	30.092	4th	28.768	18th W.
November,	56.1	4th	29.8	25th	49.4	39.7	2.584	14	29.928	30.487	30th	28.917	26th W.
December,	55.8	20th	31.0	16th	46.9	39.1	2.149	22	29.630	30.246	23rd	28.782	8th S.W., S.E.
Extremes Totals, and Means,	°	77.3	July 17th	27.6	Jan. 25th.	°	26.994	Days 49.8°	"	"	Jan. 23rd.	"	Oct. 18th. W., S.W., N.W.

TRINITY COLLEGE METEOROLOGICAL OBSERVATORY.

In January, 1904, the Provost and Senior Fellows of Trinity College established a Normal Climatological Station within the precincts of the College. The station occupies an open space in the Fellows' Garden, and is fully equipped. In addition to the usual instruments—barometer, dry-bulb, wet-bulb, maximum and minimum thermometers, and rain-gauge, all of which are read at 9 a.m. and 9 p.m.—the equipment includes a Campbell-Stokes sunshine-recorder and two earth-thermometers, of which the bulbs are placed underground at a depth of one foot and four feet respectively. The Observatory is under the superintendence of Erasmus Smith's Professor of Natural and Experimental Philosophy, W. E. Thrift,
M.A., F.T.C.D.

The following Tables have been compiled from the records of this Climatological Station, extending over the four years 1904 to 1907, inclusive. They show the monthly and yearly values of the underground temperatures at four feet and of the duration of bright sunshine in hours and percentages.

TABLE showing the Monthly and Yearly duration of Bright Sunshine in hours, with the percentage of the greatest possible duration, together with the averages for four years.

Year .	1904.		1905.		1906.		1907.		Average.	
	Month.	Hours.	Per cent.	Hours.						
January, .	45·3	18	39·5	16	42·7	17	47·0	19	41·25	17·50
February, .	37·3	13	84·9	31	84·6	31	76·0	28	70·70	25·75
March, .	89·8	25	146·0	40	122·8	34	138·0	38	124·15	34·25
April, .	168·0	40	105·0	26	182·0	44	117·0	28	143·00	34·25
May, .	192·5	39	215·7	44	132·5	27	173·0	36	178·43	36·50
June, .	231·5	46	217·6	44	210·3	42	129·0	26	197·10	39·50
July, .	201·0	40	162·2	32	184·8	37	173·0	35	180·25	36·00
August, .	183·8	41	121·9	27	176·9	39	151·0	34	158·40	35·25
September	150·0	40	120·4	32	169·4	45	98·0	26	134·45	35·75
October, .	84·3	26	92·7	29	99·7	31	55·5	17	83·05	25·75
November, .	35·2	14	47·3	19	43·8	17	34·0	13	40·10	15·75
December, .	33·3	15	31·3	14	19·9	9	24·0	10	27·13	12·00
Yearly Totals and Means, .	1452·0	33	1384·5	31	1469·4	34	1215·6	28	1378·01	31·50
		Hours.	Hours.		Hours.		Hours.		Hours.	

TABLE showing the Monthly and Yearly Mean Temperature of the Subsoil at a depth of four feet below the Surface, together with the Average Subsoil Temperature for four years.

Month.	1904	1905	1906	1907	Average.
January, .	42·9	44·7	44·7	44·0	44·1
February, .	42·5	44·2	43·4	42·2	43·1
March, .	43·3	44·1	44·0	44·2	43·9
April, .	46·3	46·4	45·9	46·4	46·3
May, .	50·0	50·3	48·6	49·8	49·7
June, .	54·2	54·6	53·9	52·9	53·9
July, .	56·7	58·6	56·5	55·7	56·9
August, .	57·9	58·5	58·4	57·3	58·0
September, .	56·4	56·1	58·0	56·3	56·7
October, .	53·2	51·9	54·0	53·8	53·2
November, .	50·0	46·7	48·8	49·4	48·7
December, .	45·3	45·6	46·7	45·3	45·7
Yearly Means,	49·9	50·1	50·2	49·8	50·0

BOTANY.

VEGETATION-STUDY IN THE DUBLIN DISTRICT.

BY R. LLOYD PRAEGER, B.E., B.A., M.R.I.A.

THE counties of Dublin and Wicklow are the only area in Ireland in which detailed studies of the plant associations which compose the vegetation have as yet been carried out. Although these surveys include but a very small portion of the total area of the two counties, still, having been executed in areas selected for the variety of conditions there prevailing, they convey a good idea of the whole, and permit of a certain amount of generalization. The areas mapped consist of some 200 square miles lying between Dublin city on the north and Lough Bray on the south ; of the island of Lambay ; of the coast area of County Dublin north of the city ; and of five square miles surrounding the Vale of Glendalough ; but the results of the last two of these surveys have not as yet been published.

The physical features of Dublin and Wicklow are dealt with below in Mr. Colgan's floristic account ; speaking generally, the district offers a broad contrast of plain and hill. North of the Liffey the fertile drift-covered plain of County Dublin, formed mainly of Carboniferous limestone, has an average elevation of about 150 feet. South of the Liffey, the granite highlands of Wicklow present the largest area of high ground to be found in any Irish county. The Dublin plain has the lowest rainfall in Ireland—under 80 inches ; the precipitation in the heart of Wicklow is probably double this amount.

The plain is so highly tilled that no indication remains as to the types of vegetation which originally occupied it ; but it has been famous for cattle-grazing from early historical times. As one begins to ascend the hills—especially, as along the north-eastern slope, where the granite crops out at a low elevation—the Common Gorse, *Ulex europeus*, becomes conspicuous, and in rough ground dominant. It forms a rather ragged bush-formation, and is accompanied

by low trees of Hawthorn and Holly, and scramblers such as Brambles and Roses. The canopy of shrubs is sufficiently thin to allow of a considerable undergrowth of shade plants. Ascending further, the Common Gorse gives way to its ally the Dwarf Gorse, *Ulex Gallii*, which grows in close dwarf rounded masses, set sometimes in a hill-pasture association, sometimes (where the ground is peaty rather than loamy) in a *Calluna* association. Here other bushes are rare or absent, and the closeness of the *Ulex* bushes allows of no undergrowth. The Bracken, *Pteris Aquilina*, forms large colonies at various elevations, but most frequently in this *Ulex Gallii* zone. It appears quite able to hold both species of Gorse, and Ling also, in check, and controls the vegetation over quite large areas. It often shelters an abundant shade-vegetation formed of woodland plants, such as Wild Hyacinth, Wood Violets, Wood Anemones, and Primroses.

As one gets up on the high ground, at about 1000 to 1500 feet, heather-moor supervenes over the associations of the lower slopes. The lower zone of this generally consists mainly of Ling, *Calluna vulgaris*, which occupies the greater portion of the mountain land, and ascends in many places to the tops of the highest hills. This association, one of the most characteristic and most familiar of British plant societies, offers in our area the usual features, and need not be further described here. But while this species is seldom wholly absent from the high grounds, several other associations, in which it plays but a subsidiary part, are developed. On the flatter summits and ridges of those hills which lie inside County Dublin, for instance, and also elsewhere, *Scirpus cespitosus* increases in the wet bogs, and *Calluna* diminishes, till the former becomes clearly dominant. The rough, heathery vegetation gives way to a shorter, smoother, sward-like type, which in autumn assumes a beautiful and characteristic golden-brown tint, caused by the fading stem of the *Scirpus*. Again, generally on high flat summits, the moss *Racomitrium lanuginosum* forms great bosses several feet in height, and several yards across, and gives rise to a very peculiar formation. The windward (south-west) side of the bosses is mainly occupied

in grey Rhacomitrium, while in the sheltered and comparatively good drainage on the other side, a striped heath-vegetation dominates, the ground between the bushes being occupied by pools, ancient peat, or drainage-channels, with a starved *Lycopodium* vegetation. In a few spots on the Dublin hills also Cotton-grass moor is developed.

So much for the leading types of vegetation on the hills in the vicinity of Dublin. In the district around Glendalough the two Gorse formations are more locally developed. Calluna moor is conspicuous as usual. On dry hill-sides and scarpes on the flates, *Erica cinerea*, which appears occasionally as a dominant in similar situations on the Dublin hills, sometimes nearly completely usurps the ground. *Spiraea* moor is found on the higher grounds on a sparingly. An association, not met with on the Dublin hills, is extensively developed on the hills south of the Glendalough valley, ranging from over 2000 to under 1000 feet, namely, a *Nardus-Eriophorum vaginatum* moor. This is a wet, rough, grassy formation, whitish in winter from the abundance of *Nardus*. *Calluna* occurs on this area only casually, and *Cyperus esculentus* and *Eriophorum angustifolium* are rare. About Glendalough, too, native Birch-Oak wood occurs in sufficient quantity to be a characteristic feature. Extensive Oak-woods also occur, which, no doubt, represent the cared-for continuation of native woods.

It remains to speak of the vegetation of the coasts and islands north of Dublin. Along the sea-board there is an alternation of rocky and sandy stretches. The sandy shores exhibit the usual zoning of vegetation—first, loose sands, with *Atriplex*, *Cakile*, *Salsola*, &c.; then shifting dunes, dominated by *Psamma*, giving way to mossy and grassy sward, with *Rosa spinosissima*, *Viola Curtissii*, *V. hirta*, and in places large patches of *Salix repens*. On the North Bull, a three-mile sandbank north of the Liffey mouth, the sward gives way to salt-sward, and then salt-marsh, with *Armeria*, *Statice*, and *Plantago*, and the whole makes an excellent study in seaside vegetation.

On the rocky promontory of Howth, the summit still supports a considerable area of unspoiled heath, in which *Calluna vulgaris*, *Erica cinerea*, and *Ulex Gallii* compete for

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VEGETATION ON EAST SIDE OF LAMBAY.
Armeria maritima in bloom (below), *Matricaria modora* (above).
(From a photograph by R. Welch.)

mastery, forming a sight of wonderful beauty in the month of August. On Lambay, the only considerable island off the Dublin coast, a well-marked succession may be studied of halophiles, grass-land, Bracken, and dry Calluna moor. Some interesting variants of the maritime zone are produced by the activities of large colonies of Herring Gulls, which breed on the dry slopes.

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PHANEROGAMS AND VASCULAR CRYPTOGAMS.

BY N. COLGAN, M.R.I.A.

In the study of Irish botanical distribution, the area made up of the six maritime counties lying between Belfast Lough on the north and Waterford Haven on the south may be conveniently regarded as forming an East Coast province. The flora of the province so defined has, on the whole, been well explored, and the total of its flowering-plants and higher cryptogams may be estimated with considerable accuracy at 878 species, excluding from the enumeration all segregates not counted in the distributional statistics of "Irish Topographical Botany." Of this total, 804, or fully 91 per cent., are found in what may be called the central section of the province, the area formed of the two contiguous counties of Dublin and Wicklow, whose botanical characteristics are to be discussed here in some detail.

Separately considered, each of these counties has certain defects of habitat, which find expression in corresponding defects of flora; yet, taken together, they present the most varied conditions of soil and surface. Wicklow has the

lakes, the native woods, and the high-lying mountain cliffs which are altogether wanting in Dublin ; while Dublin has the large areas of low-level limestone which Wicklow lacks. Wicklow is pre-eminently a highland region. It possesses the loftiest summit in East Ireland, Lugnaquilla, whose huge mass, with flanks carved into deep cliff-headed hollows, like Pyrenean *cirques*, rises to a height of 8099 feet. Many other Wicklow summits exceed 2000 feet ; one of them, Mullaghcleevaun, reaches 2789 feet ; another, Thonelagee, 2684 ; and it has been estimated that fully 195 square miles, or one-fourth of the total area of the county, lies above the 1000 feet contour line. Contrasted with Wicklow, Dublin may be said to be a lowland area. Its southern extremity is, indeed, invaded by the mountain mass which overspreads Wicklow, and some of the Dublin summits rise well over 2000 feet ; yet no more than 28 square miles of its total area of 854 square miles lie above the 1000 feet contour line. One feature characteristic of most of our Irish counties, low-lying peat bog, is wanting both in Dublin and Wicklow ; but this defect has little or no influence on the flora of the combined counties, as almost all of the widespread bog plants commonly found at low levels in Ireland, such as *Galium uliginosum*, *Andromeda Polifolia*, *Erica Tetralix*, *Vaccinium Oxyccous*, *Utricularia minor*, *Pinguicula lusitanica*, *Myrica Gale*, and *Rhynchospora alba*, are found in the extensive mountain bogs of one or other, if not in both, of the counties.

Looking at the East Coast province as a whole, it cannot be said that its flora of 878 species is an exceptionally rich one, even judged by Irish standards of botanical richness. If we compare it with a corresponding West Coast Irish province, made up of the eight maritime counties lying between the Kenmare River on the south and the Erne estuary on the north—and Mr. Praeger's "Irish Topographical Botany," supplemented by records since published, gives us the material for making such a comparison with substantial accuracy—we find that it is poorer by some 22 species than the western province, which shows a total of 900 species. To an English botanist, familiar with his

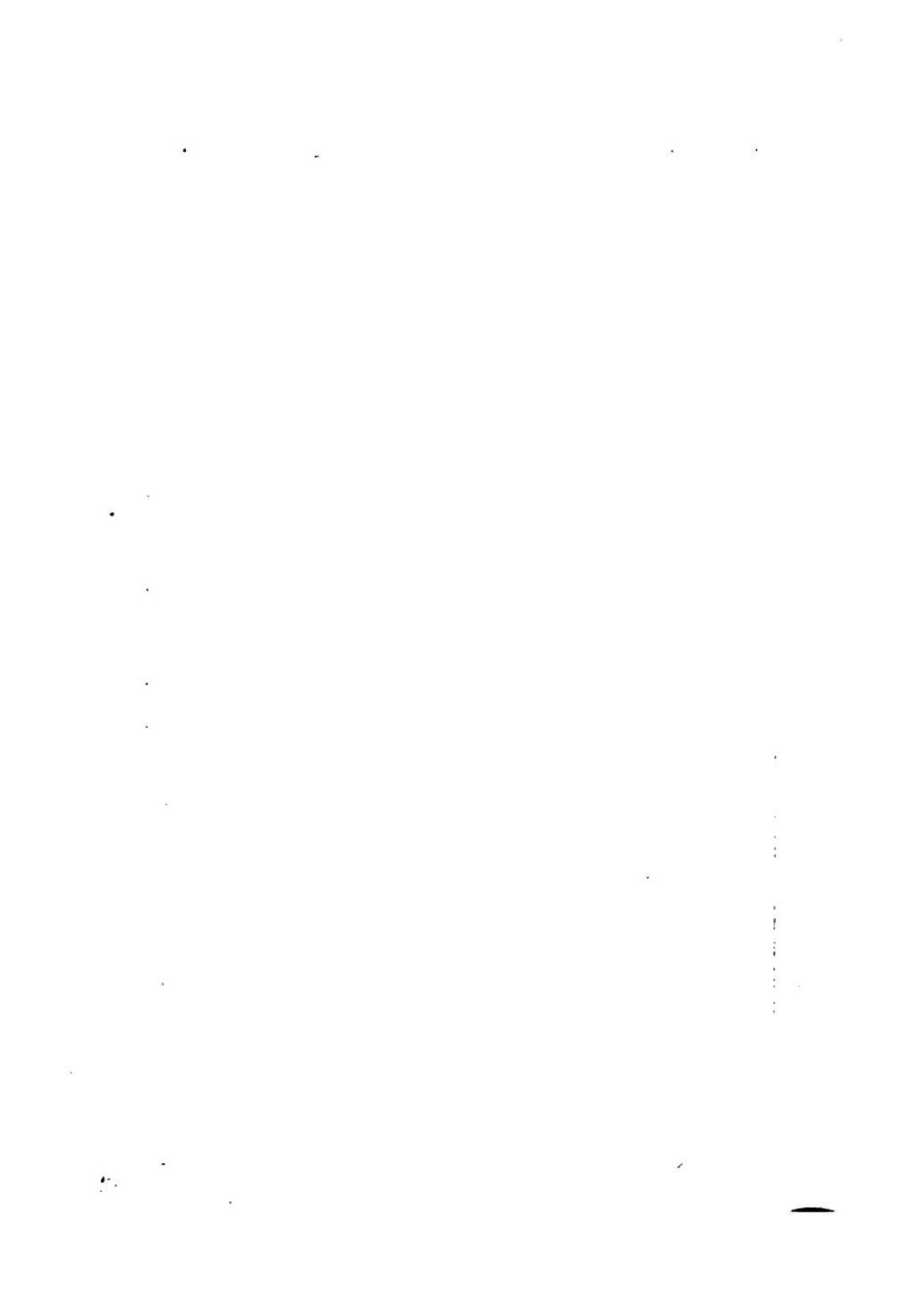


PLATE IV.

[To face page 77.



Dioscorea candidissima AT LADY'S ISLAND LAKE, CO. WEXFORD.

(From a photograph by W. Andrews & Sons.)



southern or south-eastern counties, our East Coast flora will appear absolutely poor. Kent, with an area of 1570 square miles, has a flora of 1030 species. The Irish East Coast province, with an area of 4215 square miles, has a flora of but 878; and this comparative poverty of the Irish province becomes all the more striking when we bear in mind that Kent is altogether lowland, while East Ireland includes two extensive and lofty mountain groups, the Wicklow mountains, and the Mourne mountains in County Down. Such a comparison as this brings into strong relief the essentially insular character of our Irish flora.

It is by no means easy to fix on any positive characteristic in the flora of the East Coast province or in the floras of Dublin or Wicklow. All of them are exclusively British in their composition, since they contain no species not known to occur in Great Britain, unless the *Equisetum, E. Moorei*, of the Wicklow and Wexford coasts be considered worthy of specific rank. When we compare the East Coast with the West Coast flora, however, we find that a small group of species is present in the East, but entirely absent from the West, and these species, which are set out in the list given below, may be taken as truly characteristic of the East Coast. Some of them show a tendency to a south-eastern, others to a north-eastern distribution, yet all undoubtedly find their focus in the East Coast province, and all are present in its central section, made up of the counties of Dublin and Wicklow.

Species characteristic of East Ireland.

<i>Thalictrum dunense.</i>	<i>Cynoglossum officinale.</i>
<i>Sisymbrium Sophia.</i>	<i>Lamium Galeobdolon.</i>
<i>Hypericum hirsutum.</i>	<i>Atriplex farinosa.</i>
<i>Trifolium scabrum.</i>	<i>Scilla verna.</i>
<i>T. glomeratum.</i>	<i>Carex divisa.</i>
<i>T. subterraneum.</i>	<i>Glyceria Borreri.</i>
<i>Trigonella ornithopodioides.</i>	<i>Festuca uniglumis.</i>
<i>Senecio erucifolius.</i>	<i>Equisetum Moorei.</i>

This group, although not exclusively maritime, has a very strongly marked maritime *facies*, no less than 13 of its 16 species being such as, in Ireland at least, occur only by the sea-shore or in its immediate vicinity.

Another positive feature of the East Coast flora, and one which is most accentuated in the County of Dublin, is the large proportion of alien or recent species as compared with those of native standing. In Dublin, the proportion of such species, including aliens, denizens, and colonists, as defined by Watson, is rather more than one-fifth, or 164 species out of a total of 752. Amongst these alien species of County Dublin, four are of peculiar interest—*Senecio Cineraria*, *Artemisia Stelleriana*, *Medicago sylvestris*, and *Matricaria discoidea*. The first, a native of the rocky shores of the Mediterranean, has, within the last quarter of a century, effected a permanent settlement on the sea-cliffs above Killiney Bay, some eight miles south-east of Dublin city. First introduced to a neighbouring garden as a foliage plant, it has gradually spread, by means of its wind-borne seeds, to the warm southward-facing cliffs and banks, which are now completely covered by its silvery masses. The southern alien has not only made itself thoroughly at home here, but has produced a well-marked natural hybrid, $\times S. alboescens$, by crossing with its native congener the Common Ragwort. Fully as well established as this southern alien is the Siberian Wormwood, *Artemisia Stelleriana*, a distinctly northern species, which within the last twenty years has taken possession of a considerable area of wild sand-dune on the North Bull in Dublin Bay. Here, in spite of its undoubted origin as a garden outcast, it now looks as thoroughly native as its associate *Psamma arenaria*. On sandy banks at Portmarnock, and again $8\frac{1}{2}$ miles further north, at Malahide, the rare *Medicago sylvestris* is well established, and has been for at least thirteen years. All of these aliens are apparently confined in Ireland to County Dublin. It is otherwise with *Matricaria discoidea*, a native of Northern Asia and Western North America. First recorded for Ireland from a County Dublin station in 1894, it has since been found in no less than twenty-four other Irish counties or vice-counties, in some of which, especially towards the west, it is quite abundant, and apparently of long standing.

If we take the flora of Dublin as exhibiting the main characteristics of the Irish East Coast, and that of West

Galway as typical of the West Coast province, and compare the northern and southern elements in each flora, we arrive at the somewhat unexpected result that Dublin, with its more rigorous climate, has a flora of distinctly more southern character than that of West Galway. Grouping Watson's Highland, Scottish, and Intermediate type plants as indicative of the northern element in the flora of the British Isles, and his English, Atlantic, and Germanic types as indicative of the southern element, we find that the northern element in West Galway forms fully 8 per cent. of the total flora, while in Dublin it forms but 3·3 per cent. On the other hand, the southern element, which in West Galway forms but 19 per cent. of the total flora, reaches in Dublin 25½ per cent. It may be objected that the lack in Dublin of suitable habitats for alpine species, with the consequent poverty of that county in Highland type plants—which number but 5 out of a total flora of 752—makes the comparison of Dublin with West Galway unjust. But if we add Wicklow, with its large and varied mountain area, to Dublin, and compare the combined flora of 804 species with the flora of West Galway, the preponderance on the east coast of the southern element remains unchanged. It forms, in fact, 26 per cent. of the total flora, as compared with 19 per cent. in West Galway, although the northern element is increased for the East Coast area from 3·3 to 5 per cent.

As further exemplifying this preponderance of the southern over the northern element in the East Coast flora, it may be noted that the following species, whose distribution in Ireland is distinctly southern, find the northern limit of their Irish range in County Dublin, where many of them are at least locally abundant, while no reverse tendency to a southward range of distinctively northern Irish species can be detected by analysis of the Dublin flora :—

<i>Ranunculus Lenormandi.</i>	<i>Wahlenbergia hederacea.</i>
<i>Viola hirta.</i>	<i>Erythraea pulchella.</i>
<i>Trifolium sebrium.</i>	<i>Lamium Galeobdolon.</i>
<i>Ornithopus perpusillus.</i>	<i>Carex divisa.</i>
<i>Inula crithmoides.</i>	<i>Glyceria Borreri.</i>

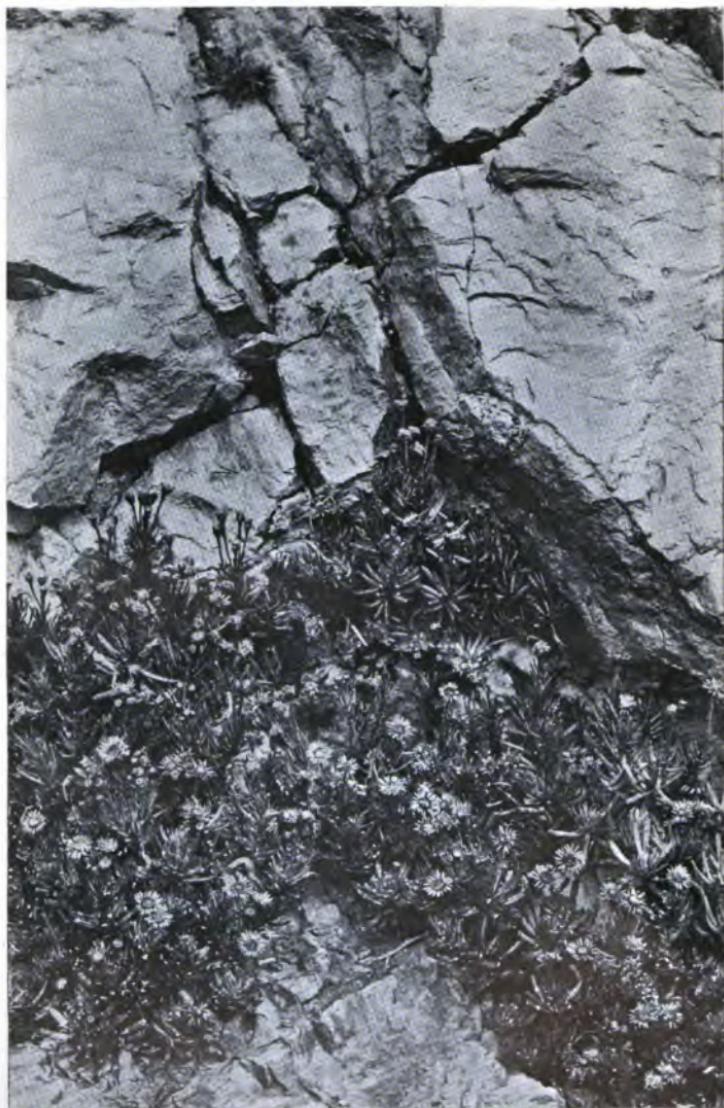
Again, if we compare the alpine floras of Wicklow and of West Galway, we find that Wicklow, in spite of its large area of lofty mountains, has but 16 species of Watson's Highland type as against 25 occurring in West Galway. So rare, moreover, are four of these Wicklow alpines—*Alchemilla alpina*, *Saussurea alpina*, *Sedum Rhodiola*, and *Cryptogramme crispa*—the three first-named of which are confined each to a single station—that an industrious and ruthless collector might easily exterminate them in a two-days' marauding tour.

Passing from these general considerations on the East Coast flora, as exemplified in Dublin and Wicklow, a few details may be given as to the floras of each of these counties viewed separately. While Dublin has been systematically explored quite recently, no competent botanist has hitherto found the courage to attempt the far more arduous task of a thorough survey of Wicklow. But a great deal of desultory work has been done from time to time, especially amongst its higher mountains, so that the flora of the county, as a whole, is fairly well known; and no great increase in its present total of 720 species is to be expected from a more methodical exploration. One district in the Wicklow lowlands may be said to be well explored, the highly interesting Murrough, a long, narrow stretch of shingly beach and sandy pasture, backed by marshes, and extending for several miles along the coast northward of the town of Wicklow. Here *Glaucium luteum* and *Calystegia Soldanella* are characteristic species covering wide areas; *Trigonella ornithopodioides*, *Trifolium glomeratum*, and *T. subterraneum*, all very rare in Ireland, and the last-named peculiar, as an Irish species, to this county, occur near Wicklow town; *Ranunculus Lingua* and *Thalictrum flavum* are found in the inland marshes; and, rarest of all the Murrough species, if not already become extinct there, as it has in other Irish stations, is the beautiful *Mertensia maritima*, recorded for this station by Sherard about 1691. Two maritime species of southern distribution in Ireland, *Juncus acutus* and *Scirpus parvulus*, though they do not reach so far northward as the Murrough, attain in Wicklow the northern limit of their Irish range.

Of the higher mountain regions of Wicklow, perhaps Lugnaquilla and Lough Bray and its surroundings are amongst the districts best known to botanists. Considering its elevation, its great extent, and its considerable area of lofty cliffs, the flora of the highest mountain in East Ireland is extremely poor. It yields only nine Highland type species, *Saxifraga stellaris*, *Sedum Rhodiola*, *Hieracium anglicum*, *Vaccinium Vitis-Idaea*, *Salix herbacea*, *Carex rigida*, *Lycopodium alpinum*, *Selaginella selaginoides*, and *Isoetes lacustris*, not one of which is rare in Ireland. No trace is to be found here of *Saxifraga oppositifolia*, of *Oxyria reniformis*, or of any of the forms of *Saxifraga hypnoides*, all of them species widespread in West Ireland, and all of them absent throughout the Irish East Coast province. The twin glacier lakes of Lough Bray, dammed up by moraines at the head of Glencree, are well known to botanists as the home of *Isoetes Morei*, a peculiar long-leaved variety or form of *I. lacustris*, discovered in the upper lake by the late A. G. More in 1872. Hidden in the old Ling, close by the lakes, *Listera cordata* grows luxuriantly; *Vaccinium Vitis-Idaea* occurs on roadside banks; *Andromeda Polifolia* is found in wet bogs high on the slopes of Kippure, above the lakes; and a little below them *Wahlenbergia hederacea*, the most delicately beautiful of all our Irish flowering plants, is abundant on moist banks, and by roadside runnels.

While dealing with the flora of the Wicklow highlands it may be noted that four of our most interesting lowland plants attain in this mountain group, including its northward extension into County Dublin, their highest known points in Ireland. In South Dublin, *Vaccinium Oxyccoccus* occurs at 1900 feet, and *Wahlenbergia hederacea* at 1600 feet above sea-level; in Wicklow both *Andromeda Polifolia* and *Ranunculus Lenormandi* have been found at a height of 1900 feet. The numerous lakes of the Wicklow highlands, so far as they have been explored, do not appear to be rich in lacustrine species. Several of them, however, yield *Lobelia Dortmanna* and *Isoetes lacustris*; *Littorella lacustris* is frequent, and Loughs Dan and Tay yield *Nitella gracilis*, only certainly known as Irish from this county.

The flora of County Dublin, judged by the Irish standard, is undoubtedly a rich one, its total of 752 species being exceeded only in the counties of Antrim and Down, with areas from two and a half to three times as large. This richness is largely due to the great variety of the coastline. Here sand-dune, rock-cliff, salt-marsh, drift-bank, muddy estuary, and shingly beach, occurring in frequent alternation, offer congenial habitats to all classes of seaside plants, so that no less than seventy out of a total of eighty maritime species included in the Irish flora are found on the Dublin coast. The varied soils of the county also conduce to the richness of its flora. Calcareous and non-calcareous tracts recur with frequency as the higher grounds, the Naul Hills, Lambay, Howth Head, and the lofty granite domes and ridges in the south emerge from the sheet of limestone drift which overspreads the greater part of the lowlands. This alternation of calcareous and non-calcareous formations makes the study of the soil-relations of plants peculiarly easy in Dublin. Within a very short space one can often pass from a typically calcicole to a typically calcifuge flora. In Glenasmole, or the Upper Dodder valley, for instance, as you mount the great drift-banks which cling to the eastern flank of the valley, a mere remnant of the mass of drift which once choked up this fine glen, you note the abundance of such characteristic calcicole species as *Anthyllis Vulneraria*, *Carlina vulgaris*, *Leontodon hispidus*, *Crepis taraxacifolia*, *Chlora perfoliata*, and *Origanum vulgare*. Descend some 80 or 100 feet to the valley floor, and you find yourself on the old river bed, a wide tract of "free-stone," as the disintegrated granite is called in southern Dublin. You have left behind you with the drift its typical limestone species, and have entered into a calcifuge region. The Common Broom is all around you in abundance, and with it appear a host of other lime-shunning species, such as *Galium saxatile*, *Peplis Portula*, *Gnaphalium uliginosum*, *Senecio sylvaticus*, *Jasione montana*, *Digitalis purpurea*, *Polygonum Hydropiper*, *Rumex Acetosella*, and *Equisetum sylvaticum*. To take one other instance out of many that present themselves: as you mount from sea-



GOLDEN SAMPHIRE (*Inula crithmoides*) ON THE CLIFFS AT HOWTH.
(From a photograph by R. Welch.)

UNIV.

level at the base of Killiney Hill over the drift-banks which there mask the mica-schist and granite, *Hypericum perforatum*, *Linum angustifolium*, *Anthyllis Vulneraria*, *Poterium Sanguisorba*, *Carlina vulgaris*, *Chlora perfoliata*, and other characteristic calcicoles appear, many of them in profusion ; but no sooner have you reached the emergent granites of the hill than the character of the flora changes. The limestone species vanish, and in their place appear *Corydalis claviculata*, *Polygala serpyllacea*, *Ulex Gallii*, *Cytisus scoparius*, *Sedum anglicum*, *Galium saxatile*, *Senecio sylvaticus*, *Jasione montana*, *Erica cinerea*, *Calluna vulgaris*, *Digitalis purpurea*, and many other equally calcifuge species.

No part of Dublin so well exhibits the richness of the county flora as the Howth district. The parish of Howth, including the bold cliff-girt peninsula of Howth Head, the low, sandy neck which links it with the mainland, and the rocky islet of Ireland's Eye, has an area of some 4 square miles. In Mr. H. C. Hart's *Flora of Howth*, published in 1887, no less than 520 species of phanerogams and ferns are recorded as occurring within this small area, and subsequent exploration has raised this already large total almost to 580 species. Included in this total are many plants rare for Ireland or for the east coast province, such as—

<i>Thalictrum dunense</i> .	<i>Senecio viscosus</i> .
<i>Sisymbrium Irio</i> .	<i>Artemisia maritima</i> .
<i>Lavatera arborea</i> .	<i>Inula crithmoides</i> .
<i>Geranium sanguineum</i> .	<i>Scutellaria minor</i> .
<i>Erodium moschatum</i> .	<i>Salvia Verbenaca</i> .
<i>Ornithopus perpusillus</i> .	<i>Atriplex farinosa</i> .
<i>Trigonella ornithopodioides</i> .	<i>Scilla verna</i> .
<i>Rubia peregrina</i> .	<i>Festuca uniglumis</i> .

Two of these, *Sisymbrium Irio* and *Senecio viscosus*, as Irish species, appear to be peculiar to County Dublin ; and the last-named is confined to the Howth district.

Quite as well known to Dublin botanists as Howth are the Portmarnock Banks, a region of sand-dunes stretching for a couple of miles along the coast northward of the Howth peninsula. Here, as still farther northward in

the Portrane peninsula, the flora characteristic of sandy soils is well developed, and interesting alien species are frequent. The predominant plants of the sand-dunes proper are *Rosa pimpinellifolia*, *Cynoglossum officinale*, *Salix repens*, *Carex arenaria*, and *Psamma arenaria*. With these, or in the adjacent sandy fallows appear the following species :—

<i>Papaver Argemone.</i>	<i>Lychnis vespertina.</i>
<i>Sisymbrium Sophia.</i>	<i>Vicia lathyroides.</i>
<i>Diplotaxis muralis.</i>	<i>Saxifraga tridactylites.</i>
<i>Viola hirta.</i>	<i>Gentiana Amarella.</i>
<i>V. Curtisii.</i>	<i>Myosotis collina.</i>
<i>Cerastium arvense.</i>	<i>Echium vulgare.</i>
<i>C. tetrandrum.</i>	<i>Lycopsis arvensis.</i>
<i>C. semidecandrum.</i>	

In the damper hollows, *Epipactis palustris* occurs along with the dwarf variety *arenarium* of *Equisetum variegatum*, and *Selaginella selaginoides*, the last-named species being rather more abundant here and in similar stations at Portrane than it is in the Dublin mountains. Amongst the rarer aliens are *Reseda alba*, *Silene anglica*, *Medicago sylvestris*, *Valerianella dentata*, *V. Auricula*, *Cichorium Intybus*, and *Calamintha Acinos*.

The island of Lambay is botanically interesting, as affording a well-defined area within which an indigenous flora may be said to reign supreme. Cultivation, long since abandoned save for a couple of acres of walled garden, has left but little mark on the flora of the island as a whole; yet, curiously enough, four species alien or doubtfully native in Dublin, i.e., *Sambucus nigra*, *Hyoscyamus niger*, *Chenopodium Bonus-Henricus*, and *Iris fætidissima*, are found here more fully established and in far wilder stations than on the mainland. The first-named species, a favourite cottage-garden tree, and always open to strong suspicion of introduction in its mainland stations, occupies almost all of the wild corries which furrow the cliffs of the northern face of the island. Here, utterly remote from all present or recent cultivation, the miniature Elder groves make a conspicuous feature of the cliffs, especially when viewed from the sea.

Amongst the rarer native plants of Dublin three, *Lychnis diurna*, *Agrimonia odorata*, and *Inula crithmoides*, have their county head-quarters on Lambay.

It is only along the Liffey valley from Chapelizod to Leixlip that woodland of any considerable extent is to be found in Dublin, and here either in the woods or on the river banks or roadsides a number of the rarer species of the county are found, while one interesting pond-weed occurs in the river itself. The following are the rare species of the Liffey valley, one of them, *Scrophularia umbrosa*, so far as our present knowledge goes, being confined in Ireland to this river valley in Dublin or Kildare :—

<i>Aquilegia vulgaris.</i>	<i>Verbena officinalis.</i>
<i>Hypericum hirsutum.</i>	<i>Calamintha Acinos.</i>
<i>Hieracium vulgatum.</i>	<i>Salvia Verbenaca.</i>
<i>Orobanche Hederæ.</i>	<i>Lamium Galeobdolon.</i>
<i>Lathraea squamaria.</i>	<i>Potamogeton decipiens.</i>
<i>Scrophularia umbrosa.</i>	<i>Equisetum hyemale.</i>

The vertical distribution of plants in the County Dublin has been so fully worked out as to permit of certain general results being stated with confidence. The shrinkage of flora, that is to say, the decrease in the number of species, with increase of elevation, which may, perhaps, be regarded as one of the laws of plant-distribution, at least in temperate regions, is very clearly exhibited in the zonal floras of Dublin. While the purely lowland zone, lying between sea-level and 750 feet elevation, yields 740 species, the flora of a succeeding zone, reaching from 750 to 1000 feet, drops to 383 species, or less than one-half. And more striking still is the result when we compare the lowland zone with the purely highland zone of the county of about equal vertical extension, 1750 to 2450 feet, for here we find that the flora has dropped to 51.

An inquiry into the various causes which operate in affecting this remarkable shrinkage can hardly be said to fall within the scope of these disjointed notes. It belongs rather to that closer study of habitat and environment which under the name of *œcology* has of late years engaged the attention of many earnest workers.

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MUSCINEÆ.**MUSCI.**

By DAVID McARDLE.

THE two counties are favourably situated for the growth of many species of these interesting plants.

In County Wicklow only certain districts have been thoroughly worked, and much collecting remains to be done. The neighbourhoods of Lough Bray and Altadore Glen have been a favourite collecting-ground of many excellent bryologists, such as Taylor, Mackay, and Moore. From here they pushed on to Glenmalure and Lugnaquilla, &c. The number of species known to grow in the county is about 219, with 18 or more varieties, which will be seen to be less than the number known to grow in the small County of Dublin, with an area of only 854 square miles. County Dublin is rich in mosses, some of which are very rare. Sand-dunes margin the north coast about Portmarnock and Malahide. Kelly's Glen produces many very rare species; the same is true of the glens about Killakee, and on to Glenasmole. The banks of the River Liffey about Lucan and Leixlip are excellent collecting-grounds. On rocks around the coast-line there is a remarkable abundance of a few genera of mosses, such as Grimmia, Weisia, Trichostomum, &c. The number of mosses known up to the latest research in County Dublin is 250 species and numerous varieties, which is more than half the total found in all Ireland.

IRISH MOSES FOUND ONLY IN DUBLIN OR WICKLOW.

- Sphagnum cymbifolium* Ehrh., var. *squarrosum* Nees
and Hornsch.
Brachyodus trichodes Fürnr.
Dicranella Grevilleana Schimp.
Rhacomitrium obtusum Lindberg, var. *subsimplex* Lind-
berg.¹
Hedwigia ciliata Ehrh., var. *viridis* B. and S.
Var. *secunda* Schp.
Phascum curvicolle Ehrh.
Pottia bryoides Mitten.
Tortula Vahliana Wils., var. *subflaccida* Lindb.
Pleurochæte squarrosa Lindb.
Philonotis cæspitosa Wils.
Bryum Warneum Blandow.
B. *Marratii* Wils.
Brachythecium rivulare B. and S., var. *tenue* Dixon.
Amblystegium filicinum De Not., var. *gracilescens* Schimp.
Hypnum Patientiæ Lindb.

RARER MOSES OF DUBLIN AND WICKLOW.

- Andreaea petrophila*** Ehrh.—Lugnaquilla, W.²
A. crassinervia Bruch.—Lough Bray, W.
Tetraphis Browniana Grev.—Lough Bray, W.; Kelly's
Glen, D.
Brachyodus trichodes Fürnr.—Lough Bray, W.;
Kelly's Glen, in fruit, D.
Rhabdoweisia fugax B. and S.—Glenmalure and
Powerscourt, W.
R. denticulata B. and S.—Glenmalure and Lough
Bray, W.
Dicranella Grevilleana Schimp.—Lugnaquilla, W.
D. Schreberi Schimp.—Dunsink, D.
Cynodontium Bruntoni B. and S.—Powerscourt and
Seven Churches, W.

¹ Vide Lindberg in Acta Societatis Fennicæ, x., p. 543.² W = Wicklow; D = Dublin.

Dicranodontium longirostre B. and S.—Lough Bray and Glenmalure, W.

Dicranum Scottianum Turner.—Lough Bray and Glenmalure, W.

Fissidens exilis Hedw.—Moist banks, Co. Wicklow.

F. viridulus Wahl.—Howth, D.

Grimmia orbicularis Bruch.—Wall between Dublin and Stillorgan.

G. ovata Schwaeg.—Howth, D.

Rhacomitrium heterostichum Brid.—Lough Bray and Seven Churches, W.; Killakee glen, D.; var. **alopecurum** Hübn.—Lough Bray, W.; var. **gracilescens** B. and S.—Lough Bray, W.; Killakee glen, D.

Campylostelium saxicola B. and S.—Lough Bray, W.; Kelly's Glen, D.

Hedwigia ciliata Ehrh., var. **secunda** Schp.—Luggela and Lough Bray, W.; var. **viridis** B. and S.—Luggela and Lough Bray, W.

Acaulon muticum C. M.—Malahide, D.

Phascum curvicolle Ehrhart.—Near Dublin (Taylor).

Pottia bryoides Mitten.—Howth, D.

P. Wilsoni B. and S.—Howth and Killiney, D.; Bray Head, W.

P. Starkeana C. M.—Howth, Clontarf, and Killiney, D.; var. **brachyodus** Wils.—Killiney, D.

P. crinita Wils.—Howth, D.

Tortula rigida Schrad.—Chapelizod and Cardiff's Bridge, D.

T. Vahliana Wilson.—Glasnevin, Cabra, Blanchardstown, D.; Bray, W.; var. **subflaccida** Lindb.—Near Dublin.

T. cuneifolia Roth.—Howth.

Barbula sinuosa Braithw.—Phoenix Park, and between Portmarnock and Malahide, D.

Weisia curvirostris C. M.—Lambay, D.

Pleurochæte squarrosa Lindb.—Portmarnock and Malahide, D.; Arklow, W.

Ulota Drummondii Brid.—Powerscourt, Luggela, and between Roundwood and Annamoe, W.

Orthotrichum rivulare Turner.—Dargle River, W.

- Philonotis rigida** Brid.—Between Woodenbridge and Arklow, W.
- P. fontana** Brid. var. **falcata** Brid.—Lugnaquilla, W.
- P. cæspitosa** Wils.—Between Glenmalure and Kelly's Lake, W.
- Webera annotina** Schwaeg.—Portmarnock, D.; Seven Churches, W.; in fruit.
- Bryum Warneum** Blandow.—Portmarnock, Malahide, and North Bull, D.
- B. Marratii** Wils.—North Bull, D.
- B. obconicum** Hornsch.—Howth, D.
- B. Donianum** Grev.—Howth, D.
- B. capillare** L. var. **torquescens** Husn.—Sheephill and Ashtown, D.
- Mnium serratum** Schrad.—Dargle, W.
- Neckera pumila** Hedw.—Westaston and Powerscourt, W.
- Daltonia splachnoides** Hook. & Tayl.—Seaghane Mountain, D.
- Pterogonium gracile** Swartz.—Lough Bray and Lugela, W.; Killakee, D.
- Thuidium delicatulum** Mitten.—Malahide, D. (Waddell).
- Cylindrothecium concinnum** Schp.—Portmarnock, Malahide, Portrane, D.; Sally Gap, W.
- Brachythecium rivulare** B. and S. var. **tenue** Dixon.—Lambay, D. (Praeger, 1905).
- B. illecebrum** De Not.—Ballinascorney Gap, Howth, D.
- Eurychium speciosum** Schp.—Lambay, D.
- E. Teesdalei** Schp.—Botanic Garden, Glasnevin; Phoenix Park, D.
- E. megapolitanum** Milde.—Between Malahide and Portrane, D.
- Amblystegium confervoides** B. and S.—Lambay, D.
- A. filicinum** De Not. var. **graciliscescens** Schp.—Lambay, D.
- Hypnum elodes** Spruce.—Killiney, in fruit; Lambay, D.
- H. polygamum** Schp. var. **stagnatum** Wils.—Arklow, W.
- H. Patientiae** Lindb.—Lough Bray and Lugnaquilla, W.

Hylocomium splendens B. and S. var. **Lambayensis**
M' A.—Lambay, D.

Sphagnum cymbifolium Ehrh. var. **squarrosum**
Nees et Hornsch.—Rathdrum, W.

S. tenellum Ehrh.—Glenmalure, W.

S. Grgensohnii Russ.—Glenmalure, W.

S. fimbriatum Wils.—Lough Bray, W.

S. cuspidatum Ehrh. var. **plumosum** Nees et Hornsch.—
Lough Bray, W.

LOCAL MOSES REMARKABLE FOR THEIR GEOGRAPHICAL
DISTRIBUTION.

Sphagnum fimbriatum Wilson.—New Zealand, Tierra del Fuego, Falkland Islands.

S. subsecundum Nees.—Brazil, New Zealand.

S. acutifolium, Ehrhart.—Chatham Island, New Zealand, Andes.

S. cuspidatum Ehrh. var. **plumosum** Nees et Hornsch.—
New Zealand.

Andreaea petrophila Ehrh.—Andes, Tierra del Fuego, Tasmania, New Zealand.

A. alpina, Smith.—Tierra del Fuego.

Polytrichum formosum Hedwig.—Mexico.

Leucobryum glaucum Schp. — Jamaica, Andes, Venezuela, Brazil.

Grimmia apocarpa Hedw.—Straits of Magellan.

Hedwigia imberbis Spruce.—Andes.

Tortula papillosa Wilson.—Andes, Falkland Islands.

Weisia viridula Hedwig.—Cuba, Andes, Brazil.

Anoectangium compactum Schwaeg.—Andes.

Webera cruda Schwaeg.—Mexico, Guatemala, Tierra del Fuego.

Bryum capillare L. var. **torquescens** Husn.—Chili, Monte Video, Brazil.

B. bimum Schreb.—Andes, New Granada.

B. argenteum L.—Cuba, Andes, Brazil.

Mnium rostratum Schrad.—Venezuela, Andes, New Granada, Brazil.

Daltonia splachnoides Hook. and Tayl.—Jamaica.

Hypnum uncinatum Hedw.—Andes.

**MOSSES NOT FOUND RECENTLY IN DUBLIN AND WICKLOW,
AND PERHAPS EXTINCT.**

Tetraphis Browniana *Grev.*—Kelly's Glen, Lough Bray.
Brachythecium trichodes *Fürnr.*—Lough Bray, Kelly's Glen.

Dicranella Grevilleana *Schp.*—Lugnaquilla, June, 1864.

D. Schreberi *Schp.*—Dunsink.

Pottia bryoides *Mitt.*—Howth.

Phascum curvicolle *Ehrh.*—Near Dublin.

Tortula Yahliana *Wils.*—On mud-walls at the Botanic Gardens, Glasnevin, Cabra, and Blanchardstown. Near Bray. Var. *subflaccida* was plentiful about Glasnevin.

Daltonia splachnoides *Hook. and Tayl.*—Seeghane Mountain.

Fissidens incurvus *Starke*, var. **tamarindifolius** *Wils.*—Cullen's Wood, near Dublin.

Philonotis cæspitosa *Wils.*—On the ascent from the Hotel at Glenmalure towards Kelly's Lake.

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HEPATICÆ.

BY DAVID M'ARDLE.

Both counties have been collected in with rare discriminating power. In the neighbourhood of Lough Bray many rare species have been found by Dr. Taylor and the

late Dr. Moore. Further inland lies Altadore or Hermitage Glen, where many rare liverworts are found; while on Lugnaquilla occur representatives of alpine or sub-alpine species. The long stretch of coast-line is mostly good collecting-ground. In the glens of the Dublin hills and along the Liffey many rare species are to be found. On rocks along the coast-line, there is a remarkable difference in the number of species in certain districts. For instance, on the latest research on Lambay, only 20 species of Hepaticæ were collected. On the Hill of Howth, 9 miles distant, 55 species are known to grow. The number of Hepaticæ known at the present time, or recorded by former collectors in County Dublin, is 85 species and 10 varieties, while in the larger County of Wicklow there are 99 species and 14 varieties. In County Wicklow grow more than half the number which are found in Ireland.

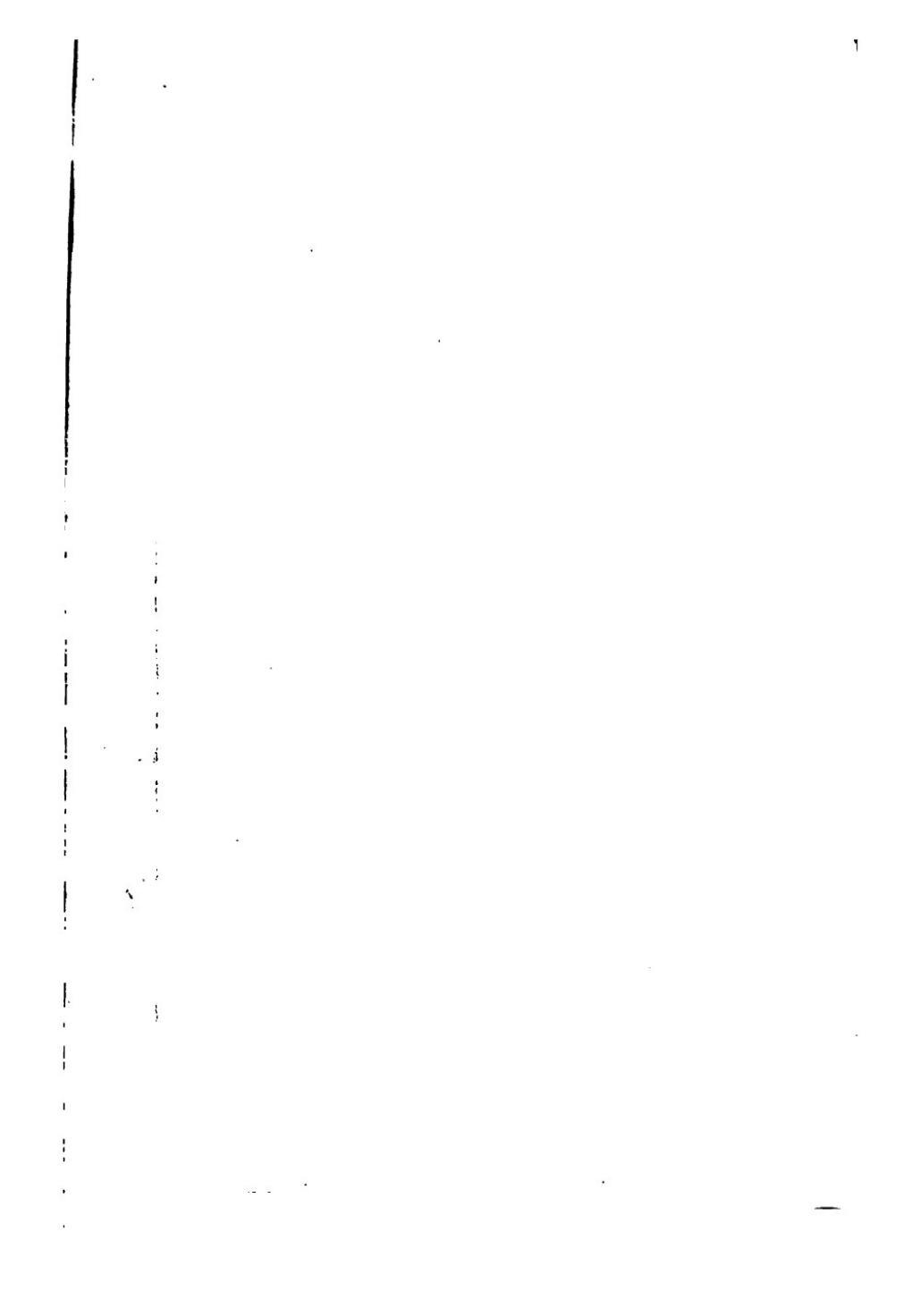
From these totals, however, a few species must for the present at least be withdrawn, pending their rediscovery. Some are perhaps extinct from one cause or another.

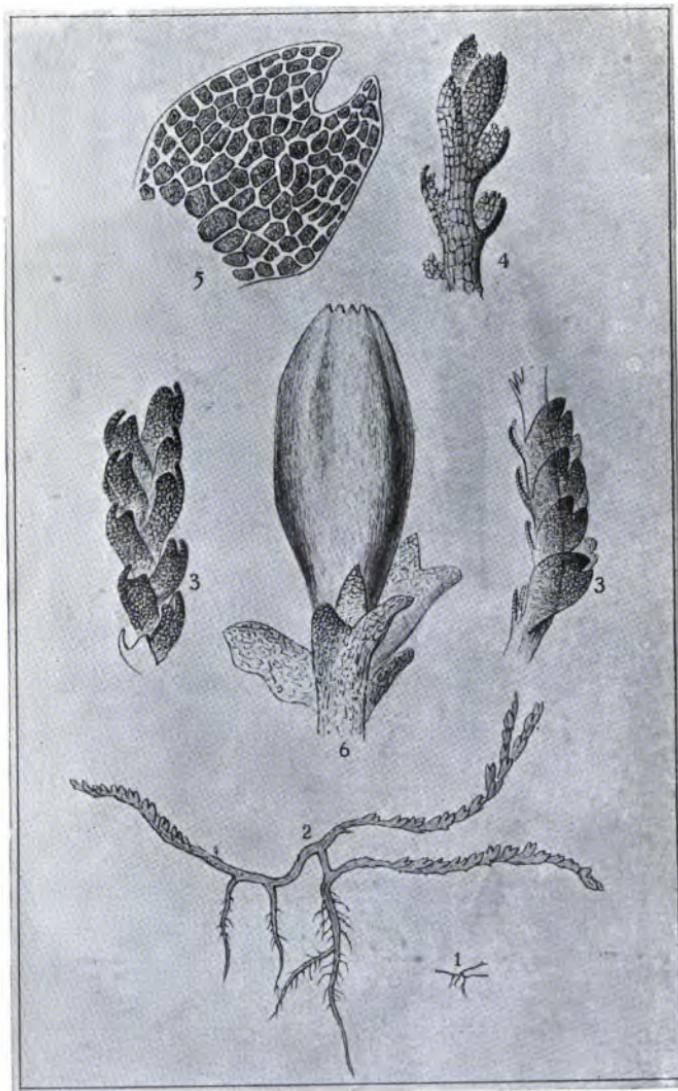
IRISH HEPATICÆ FOUND ONLY IN DUBLIN OR WICKLOW.

<i>Frullania dilatata</i> , var. pro-	<i>Nardia compressa</i> , var.
lifera.	<i>rigida</i> .
<i>Scapania subalpina</i> , var.	<i>N. scalaris</i> , var. <i>rivularis</i> .
<i>undulifolia</i> .	<i>N. scalaris</i> , var. <i>robusta</i> .
<i>Jungermania inflata</i> , var.	
<i>compacta</i> .	

PLANTS FOUND IN DUBLIN OR WICKLOW, WITH A RANGE TO THE EXTREME SOUTH-WEST—CORK AND KERRY ONLY.

<i>Frullania Tamarisci</i> , var.	<i>Jungermania bantriensis</i> ,
<i>robusta</i> .	<i>var. Hornschuchiana</i> .
<i>Lejeunea Rossettiana</i> .	<i>Dumortiera irrigua</i> .
<i>Cephalozia elachista</i> .	<i>Pallavicinia Lyellii</i> .
<i>Diplophyllum obtusifolium</i> .	





Cephalozia Francisci, Dumort.

(From Proc. R.I. Academy, Ser. 3, vol. III.)



RARER HEPATICÆ.

Jubula Hutchinsiae Hook., Dumort.—On wet rocks, Altadore Glen, W.

Lejeunea Mackaii Hook., Sprenger.—Dargle, W. (Mackay, 1812; Scully and McArdle, 1889); Woodlands, D. (Dr. Moore).

L. patens Lindberg.—Altadore Glen, W.

Var. **cochleata** Spruce.—Woodenbridge, W.

L. flava Swartz, Nees.—Altadore Glen, Luggela and Dargle, W.; Howth demesne, D.

L. ulicina Taylor.—Luggela and Powerscourt, W.; Woodlands, D.

Pleurozia cochleariformis Weiss, Dum.—Lough Bray, W.; Dublin Mountains (Moore).

Herbera adunca Dicks., Gr. & B.—Lough Bray, W.

Blepharostoma trichophyllum Linn., Dumort.—Lough Bray, W.

Lepidozia cupressina Swartz.—Lough Bray, W.; Howth, D.

L. trichoclados C. Mill.—Lough Bray and Lugnaquilla, W.; Howth, D.

Cephalozia pallida Spruce.—Lough Bray, W.; Howth, D.

C. Francisci Hook., Dumort.—Howth, D.

C. fluitans Nees, Spruce.—Howth, D.

C. denudata Nees, Spruce.—Howth, D.

C. elachista Jack, Lindberg.—Lough Bray, W.; Howth and Ireland's Eye, D.

Scapania compacta Roth., Dumort.—Between Woodenbridge and Arklow, W.; Lambay, D.

S. umbrosa Schrader, Dumort.—Longh Bray, Boula-cross Mountain, Powerscourt, W.; Killakee and Kelly's Glen, D.

S. curta Mart., Dumort.—Lough Bray, W.

Diplophyllum obtusifolium Hook., Dumort.—Glendhu, D.

Lophocolea spicata Taylor.—Altadore Glen, W.

Harpanthus scutatus W. & M.—Lough Bray, W.

Mylia anomala Hook., Gr. & B.—Lough Bray, W.

- Jungermania pumila*** With.—Lough Bray and Dargle, W.
J. bicrenata Schmidel.—Lough Bray, W.; Howth, D.
J. exsecta Schmidel.—Lough Bray, W.
J. exsectiformis Breidler.—Lough Bray, W.
J. gracilis Schleicher.—Howth, D.
J. minuta Crantz.—Lough Bray, Seven Churches, Glencullen, W.; Howth, D.
Nardia hyalina Lyell, Carrington.—Luggela, Lough Bray, Seven Churches, Glencullen, Arklow, W.; Seefin Mountain, D.
Marsupella sphacelata Giesecke, Dumort.—Lough Bray, W.
Cesia corallicoides Nees.—Lugnaquilla Mountain, W.
Scalia Hookeri Lyell, Gray and Benn.—Malahide, D.
Petalophyllum Ralfsii Wils., Gott.—Malahide, North Bull, D.
Pallavicinia Lyellii Hook., Gr. and Benn.—Lough Bray, W.
P. hibernica Hook., Gr. and Benn.—Lough Bray, W.
 Var. ***leptodesma*** Tansley.—Malahide, Portrane, North Bull, D.
Aneura palmata Hedwig, Dumort.—Powerscourt, Altadore Glen, W.
Reboulia hemisphærica Raddi.—North Bull, D.
Preissia commutata Lindenbergs, Nees.—North Bull, D.
Dumontiera irrigua Wilson, Nees.—Altadore Glen, Luggela, W.
Ricciocarpus natans Linn., Corda.—Inchicore, D.
Anthoceros punctatus Linn.—Sugarloaf Mountain, W.; Kelly's Glen, Malahide, D.

LOCAL HEPATICÆ REMARKABLE FOR THEIR GEOGRAPHICAL
DISTRIBUTION IN THE TROPICS AND SUB-TROPICS.

- Jubula Hutchinsiae***.—Pacific Islands.
Lejeunea hamatifolia.—Gold-bearing districts, Kynsna, S. Africa.
L. flava.—Amazon valley, S. America.

L. patens var. **cochleata**.—Mount Tunguragua, S. America.

Pleurozia cochleariformis.—East Indies, Sandwich Islands.

Lepidozia cupressina.—W. Indies.

Cephalozia connivens.—S. Africa.

C. curvifolia.—Mexico and S. Africa.

Jungermania minuta.—Africa, Mexico.

Blasia pusilla.—N. Asia.

Aneura pinguis.—Cuba.

A. palmata.—New Zealand, Tasmania.

A. sinuata.—N. Zealand, Australia, Tasmania, Malay Islands, India, Bourbon, America.

Pallavicinia Lyellii.—S. America, Australia, New Zealand.

Metzgeria furcata.—Africa, New Zealand, Auckland Islands.

M. conjugata.—Africa.

Marchantia polymorpha.—Japan, Java.

Lunularia cruciata.—Africa, Queensland.

Dumortiera irrigua.—W. Indies, America, and S. Africa.

NORTH AMERICAN TYPES.

Lejeunea serpyllifolia. **Marsupella sphacelata**.

Porella platyphylla. **Pellia calycina**.

P. Thuja. **Anthoceros punctatus**.

Trichocolea tomentella. **Ricciella fluitans**.

Lepidozia reptans. **Ricciocarpus natans**.

Bazzania trilobata.

HEPATICÆ NOT FOUND RECENTLY, PERHAPS NOW EXTINCT.

COUNTY DUBLIN.

Lejeunea Mackaii Hook.—Woodlands.

L. hamatifolia Hook.—Woodlands.

L. calcarea Libert.—Woodlands.

L. Rossettiana Massalongo.—Woodlands.

L. calyptrifolia Hook.—Luttrellstown.

Hygrobiella laxifolia Hook.—Castlekelly Mountain.

Diplophyllum Dicksoni Hook.—Mountains near Dublin.

Nardia hyalina Lyell.—Seefin Mountain.

Cesia crenulata Gottsche.—Howth.

Ricciella fluitans L.—North Wall, Dublin.

COUNTY WICKLOW.

Lejeunea hamatifolia Hook.—Powerscourt.

Harpanthus scutatus W. et M.—Lough Bray.

Jungermania bantriensis Hook.—Lough Bray.

Anthoceros punctatus L.—Sugarloaf Mountain.

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THALLOPHYTA.

FUNGI.

By GEORGE H. PETHYBRIDGE, B.S.C., PH.D.

Before the last visit of the British Association to Dublin, thirty years ago, the only lists of Irish fungi were short and incomplete, such as Wade's with fifty species, published in 1804, and Templeton's with over two hundred, in

1840. The visit of the Association in 1878, therefore, was availed of by the late Mr. Greenwood Pim, M.A., for the publication of a list of about 470 species of fungi found in the counties of Dublin and Wicklow during the previous five years. This list appeared in the Handbook, and was also published by the Royal Dublin Society (1).¹ As Mr. Pim then pointed out, his list could not be considered as being at all a full one, and his anticipation that many more species would be added to it has been fully borne out, and to a very large extent owing to his own further work at the subject.

Five years later, in 1883, Mr. Pim published (2) a list of about seventy additions to his previous records, less than a dozen of these having been found by the Rev. M. J. Berkeley, the remainder being his own. Of these, five were new to science, and two others, *Echinobotryum atrum* and *Tetraploa aristata*, were very rare in England and on the Continent.

In 1898, Mr. Pim, in conjunction with Dr. McWeeney, read a paper before the Dublin Naturalists' Field Club, dealing with the fungi of the district in question, which was subsequently published in the Irish Naturalist (3). Appended to this paper is a list of about 245 species not hitherto recorded, bringing the total up to that time to about 780 species. The authors call attention here to the comparative absence of members of the genus *Cortinarius*, as well as that of the pink-spored Agarics and the woody or coriaceous genera. The occurrence of the gasteromycete *Cynophallus (Mutinus) caninus* (Huds.) Fr., is also noted, and attention called to a fungus new to science, and named by Grove, in honour of its discoverer, *Pimina parasitica*.² The fungus was found parasitic on a Botrytis growing on Passion-flower leaves. The fewness in numbers of Discomycetes is also remarked. After a further period of five years, Mr. Pim published in the Irish Naturalist in 1898 (4) a revised and extended list of the fungi observed up to that time in the

¹ The numbers in brackets refer to the bibliography at the end of this article.

² Journ. Bot., 1888, p. 206.

counties of Dublin and Wicklow. This list follows in the main the arrangement of Mr. Massee's British Fungus Flora (1892-95), whereas the former lists followed that of Dr. Cooke's Handbook. It contains about 820 species, over forty having been added since the publication of previous lists.

Shortly after the appearance of this list, the British Mycological Society held its annual meeting in Dublin, with the result that a further list of 160 species was compiled and published (5), thus bringing the total up to over 980 species. During the ten years which have elapsed since this time the list has further grown. Records of about fourteen additional species are to be found scattered through the pages of the Irish Naturalist for this period, having been chiefly collected and exhibited by members of the Dublin Microscopical and the Dublin Naturalists' Field Clubs. Whilst the special survey of the natural history of the island of Lambay was in progress, a list of the fungi found was prepared by Mr. David McArdle (6), and, although not specifically stated as such in the list, ten of the number appear to be new records. Mr. J. Adams also supplied a list (7) of seven species new to the district in 1907.

More recently still, the Rev. Father Torrend, s.j., has compiled a list (8) of about seventy species new to the district, which is particularly rich, comparatively speaking, in additions to the Myxomycetes, amongst which may be specially mentioned the very rare *Physarum penetrare* Rex., found growing on liverworts on the Dunran estate and in the Devil's Glen, the species having been collected only on five previous occasions and in widely distant parts of the globe. The above-named lists, together with some half a dozen or so further records of the writer's, not yet published, bring up the total number of species observed to not far short of 1100, an increase of more than 600 additional species over those known thirty years ago—by no means a discreditable one when the extremely small number of workers at this group of plants is taken into account. The time would seem an opportune one for the preparation, if not the publication, of

a revised list, brought up to date, and arranged according to modern ideas of mycological classification. Such a list in the form of a card-index might well be made, and kept for consultation in the National Museum, and would prove of much service to workers in this somewhat neglected branch of Irish botany.

As regards localities where collectors may expect to find fungi in plenty, the wooded valleys in County Wicklow may be specially mentioned, the Devil's Glen indeed having been described as a fungologist's paradise. Nearer Dublin may be mentioned the woods along the Liffey valley,¹ and those at Cruagh and Killakee, the last-mentioned being the favourite fungus hunting-ground of the Dublin Naturalists' Field Club, a list of the principal fungi to be found there being given in the *Irish Naturalist*, vol. ix., 1900, p. 267.

Finally, a word as to the extent of our knowledge of the fungi of Ireland outside of the present district may be not out of place. Unhappily what was written by Mr. Pim ten years ago still remains true. Except for the list of species in Power's "Flora of Cork," and for the list, due to Rev. H. W. Lett, chiefly for Armagh, Antrim, and Down, published by the Belfast Naturalists' Field Club in 1884-5, Ireland is practically still a *terra incognita* as far as fungi are concerned.

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¹ *Tuber aestivum* has been found in plenty at Castleknock.

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LICHENS.

BY DAVID MCARDLE.

The investigation of the local Lichens is incomplete, and our list only represents about 40 genera, 150 species, and 20 varieties.

Very little has been done during the last half century to add to our knowledge of the distribution of this interesting group. At the present time there are brighter prospects, and with the help of the Lichen Exchange Club, recently established, there is no reason why Lichens may not be as well represented in herbaria as the other groups of Irish Cryptogams.

Dr. Walter Wade published in his "Plantæ Rariores in Hibernia Inventæ," as early as 1804, 88 species of Lichens found in Ireland. The localities are not given to every species, but 12 are recorded from County Dublin, collected mostly about Howth, Bullock, and Dalkey. The only species recorded from County Wicklow is *Lichen tartareus*, which is now in the genus *Lecanora*; it was collected by the Rev. Mr. Kelly, who sent it to Wade as a Lichen much used in dyeing. The greater part of our knowledge is due to the labours of Dr. Taylor, Dr. D. Moore, Admiral Jones, and Mr. Isaac Carroll, who made large collections through Ireland. In County Wicklow, Lough Bray, Luggela, Lugnaquila, woods about Enniskerry, Altadore Glen, and the coast, were favourite collecting grounds; in County Dublin, Howth, Killiney, and woods and glens in the mountains. Admiral Jones's collection is very extensive. Dr. Moore investigated the subject with rare discriminating power; his memory is perpetuated in *Leptogium Moorei*, Hepp., a minute plant, found only at

Killarney and Glengariff. Dr. Taylor's work, which is included in part II. of Mackay's *Flora Hibernica*, is exhaustive for his time, and includes more than 350 species collected in various parts of Ireland.

The following list includes most of the rarer Lichens found in the counties of Dublin and Wicklow¹:

- Ephebe pubescens Fr.**—Dublin Mountains, Mr. Archer.
Collema pulposum Ach., var. **tenax Ach.**—Near Dublin, Dr. Taylor.
C. nigrescens L.—Dargle, W., Dr. Taylor.
Leptogium fragrans Ach.—W., Dr. Taylor.
L. palmatum Nyl.—Luggela, W., Moore and Jones.
L. muscicola Sw.—Luggela, W., Admiral Jones.
Calicium sphærocephalum Ach.—Powerscourt, W., Dr. Stokes.
C. trachelinum Ach.—Powerscourt, W., Dr. Stokes.
Cladonia papillaria Duf.—Howth, D., Admiral Jones.
C. degenerans Flk.—Kelly's Glen, D., Dr. Moore.
C. gracilis Hoffm.—Lambay, D., McArdle.
C. digitata Hoffm.—Kelly's Glen, D., Dr. Moore.
C. macilenta Hoffm.—Powerscourt, W., G. Pim.
 Var. **carcata Ach.**—Killiney, D., Dr. Moore.
C. deformis Hoffm.—Howth, D., Dr. Moore.
C. bellidiflora Schær.—Kelly's Glen, D., Dr. Moore; very rare.
Usnea articulata Ach.—Malahide, D., Dr. Mackay; Portmarnock, D., Dr. Taylor.
Platysma glaucum L.—Luggela, W., Admiral Jones.
Nephromium lusitanicum Schær.—Luggela, W. Admiral Jones.
Ricasolia herbacea Huds.—Powerscourt, W., Dr. Moore.
Parmelia prolixa Ach.—Howth, D., Dr. Moore.
P. Borreri Turn.—Near Wicklow, Dr. Maingay.
P. incurva Pers.—Howth, D., Dr. Moore; very rare.
Physcia erosa Borr.—Dargle, W., Dr. Taylor.

¹ D. = County Dublin; W. = County Wicklow.

Umbilicaria pustulata Hoffm.—Lough Dan, W., Admiral Jones.

Squamaria crassa Huds.—Skerries, D., Dr. Moore.

Lecanora subfuscata L., var. **coilocarpa**, Ach.—Lambay, D., I. Carroll.

L. calcarea L., var. **Hoffmanni** Ach.—Portmarnock and Feltrim Hill, D., Dr. Taylor.

Pertusaria Westringii Ach.—Lough Bray, W., Turner.

P. ceuthocarpa Sm.—Lough Bray, W., Turner and Borrer.

Lecidea sanguinaria L.—Lough Bray, W., Templeton and Jones.

L. gelatinosa Flk.—Kelly's Glen, D., Dr. Moore.

L. pineti Schrad.—Baltinglass, W., I. Carroll.

L. melæna Nyl.—Howth, D., Admiral Jones.

L. latens Taylor.—Dargle, W., Dr. Taylor.

L. muscorum Sw.—Malahide, D., Dr. Carrington.

L. cladoniaria Nyl.—Kelly's Glen, D., Dr. Moore, 1861, rare.

Platygrapha rimata Frv.—Loughlinstown, D., Herb. Borrer.

Endocarpon fluviatile DC.—Luggela, W., Admiral Jones; Dargle, W., Dr. Stokes.

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ALGÆ.

By J. ADAMS, M.A.

Physical Features.—Physically the area under consideration offers a considerable variety of habitats for the growth of Algæ. There are no low-level bogs in either

county. In County Dublin, the chief water-surfaces are furnished by the River Liffey and the Grand and Royal Canals, there being no lakes. In County Wicklow, the principal rivers are the Ovoca and streams flowing into it. Smaller streams are numerous; but, owing to the mountainous nature of the county, the rate of flow is usually very rapid. Small lakes abound in the county; but they are all (including the artificial reservoir at Roundwood) above the 500-foot contour-line. Owing partly to the difficulty of access, scarcely any of these have been properly investigated, Lough Bray being the only one to claim some attention. The southern part of County Dublin and nearly the whole of Wicklow are mountainous, the highest point being 8089 feet (Lugnaquilla).

Coast-line.—With regard to marine forms there is a long coast-line which, in County Dublin, is indented by muddy estuaries. There are extensive stretches of sand and shingle, almost or entirely devoid of algal life; in both counties rocky headlands are few in number, occurring in Lambay, Howth Head, Bray Head, Wicklow Head, and Mizen Head.

Changes in the Marine Area.—As showing the changes that have taken place in the sea-floor of our area, the following fact is of interest, as recorded by the late Professor O'Reilly (Proc. Roy. Ir. Acad., 1898). In 1871 *Lithothamnion* species were found in excavations for the south quay wall at a depth of 22 feet 6 inches below the low-water mark of the river. The species were probably *Lithothamnion polymorphum* Aresch. and *L. fasciculatum* J. G. Ag., both now living in Dublin Bay. Above them rested a layer of clay containing trunks and roots of trees; then a layer containing hazel-nuts; next a stratum of blue clay; and, finally, a thick layer of drift.

Previous Investigations.—Extensive researches were for many years made among the Freshwater Algæ of the Dublin district by Archer, while O'Meara was equally successful in the study of the Diatoms, both freshwater and marine; and full lists of the species observed were published in the British Association Guide to Dublin in 1878. The marine Algæ had been previously studied and recorded by

Harvey, in his great work, "Phycologia Britannica." Since their time systematic botany seems to have gone largely out of fashion, and only one paper of outstanding importance dealing with the Algae of the district has been published, namely, that of the late Mr. Batters, on the Algæ of Lambay. References to other literature are given in the Bibliography at the end.

Census of Species.—The following table shows the number of species that were known in 1878:—

		Freshwater.	Marine.
Cyanophyceæ,	...	128	11
Chlorophyceæ,	...	164	21
Conjugatæ—			
(a) Desmidiaeæ,	...	297	—
(b) Other Conjugatæ,	...	26	—
Diatomaceæ,	...	221	252
Phæophyceæ,	...	—	58
Rhodophyceæ,	...	8	108
Total	...	844	440

Since that date our knowledge has been extended by the addition of 187 species, which either were omitted from the previous list or have been discovered since:—

		Freshwater.	Marine.
Peridinieæ,	...	1	9
Cyanophyceæ,	...	8	17
Chlorophyceæ,	...	8	22
Conjugatæ—			
(a) Desmidiaeæ,	...	1	—
(b) Other Conjugatæ,	...	1	—
Diatomaceæ,	...	9	—
Phæophyceæ,	...	—	22
Rhodophyceæ,	...	1	44
Total	...	24	114

The total algal flora known at the present time, therefore, numbers 1422 species.

Time of extreme low water.—Probably one reason why more species have not been recorded from the Dublin district is to be found in the fact that low water of spring tides always occurs about 6 o'clock. Many species bear their reproductive organs in the winter months, and others are found only during that period ; and as the best time for shore-collecting is during extreme low water, it follows that for six months of the year the algologist is seriously handicapped, and that too at a time when dredging is scarcely practicable.

Rarer species.—The following are some of the rarer species occurring in the district. Some of them have not, up to the present, been found elsewhere in Ireland :—

CYANOPHYCEÆ.

Freshwater.	Marine.
<i>Merismopodium elegans A. Br.</i>	<i>Aphanocapsa marina Hansg.</i>
<i>Rivularia minutula Born. et Flah.</i>	<i>Aphanothece pallida Rabenh.</i>
<i>Tetrapedia setigera Arch.</i>	<i>Entophysalis granulosa Kütz.</i>
	<i>Plectonema norvegicum Gom.</i>
	<i>Pleurocapsa fuliginosa Hauck.</i>

CHLOROPHYCEÆ.

Freshwater.	Marine.
<i>Botrydium granulatum Grev.</i>	<i>Chætophora crassa Kütz.</i>
<i>Chaetophora elegans Ag.</i>	<i>Cladophora Balliana Harr.</i>
<i>Cylindrocapsa involuta Reinsch.</i>	<i>C. Brownii Harr.</i>
<i>Dictyosphaerium reniforme Buln.</i>	<i>Endoderma Flustre Batt.</i>
<i>Mischococcus confervicola Nüg.</i>	<i>Gloeocystis adnata Nüg.</i>
<i>Pediastrum integrum Nüg.</i>	<i>Prasiola polyrhiza Rosenv.</i>
<i>Selenastrum Bibraianum Reinsch.</i>	<i>Pringsheimia scutata Rke.</i>
<i>Sorastrum spinulosum Nüg.</i>	<i>Sykidion Dyeri Wright.</i>
<i>Stephanosphaera pluvialis Cohn.</i>	

CONJUGATÆ.

Cosmocladium Saxonicum de Bary.
Cylindrocystis diplospora Lundell.
Docidium Baculum Breb.
Micrasterias Jenneri Ralfs.
Oocardium stratum Ndg.

DIATOMACEÆ.

Freshwater.	Marine.
<i>Navicula integra W. Sm.</i>	<i>Arachnoidiscus Ehrenbergii</i>
<i>Vanheurckia vulgaris H. van Heurck.</i>	<i>Bailey.</i>
	<i>Biddulphia alternans H. van Heurck.</i>
	<i>Eupodiscus Argus Ehr.</i>
	<i>Navicula Clepsydra Donk.</i>
	<i>Podocystis adriatica Kütz.</i>
	<i>Sceptroneis caducea Ehr.</i>

Podocystis adriatica Kütz is a species characteristic of the Mediterranean and Adriatic Seas.

Arachnoidiscus Ehrenbergii Bailey, a native of tropical seas, has not been observed since it was found at Malahide by Capt. Hutton in 1864.

PHLEOPHYCEÆ.

Dictyosiphon hispidus Kjellm.
Ectocarpus brevis Sauv.
Hecatonema maculans Sauv.
Leathesia crispa Harv.
Punctaria undulata J. Ag.

It is noteworthy that *Alaria esculenta* Grev., one of the large Laminarians, so common on the North and West Coasts, has not yet been found in the Dublin district.

RHODOPHYCEÆ.

Freshwater.	Marine.
<i>Batrachospermum atrum</i> <i>Harv.</i>	<i>Acrochaetium</i> Batt. <i>Chylocladiæ</i>
	<i>Ceramium vimineum</i> J. Ag.
	<i>Compsothamnion gracillimum</i> Schm.
	<i>Goniotrichum ramosum</i> Hauck.
	<i>Microcladia glandulosa</i> Grev.
	<i>Phyllophora palmettoides</i> J. Ag.
	<i>Pleonosporium Borreri</i> Nag.
	<i>Rhodophysema Georgii</i> Batt.
	<i>Spermothamnion irregulare</i> Ardiss.
	<i>Trailliella intricata</i> Batt.

Marine Plankton.—Three species of Diatoms—namely, *Actinoptychus undulatus* Ralfs, *Cosinodiscus radiatus* Ehr., and *Melosira nummuloides* Ag.—and nine species of Peridinieæ have been obtained by Dixon and Joly off the Dublin Coast.

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ZOOLOGY.

INTRODUCTION.

BY GEORGE H. CARPENTER, B.S.C., M.R.I.A.

THE district around Dublin is of quite exceptional interest to the zoologist. The close neighbourhood of the sea, of the Wicklow highlands, of inland wooded country, and of coast sandhills ensures a great variety of ground for the collector of specimens and for the observer of animal life. Places so close to the city as Howth, Portmarnock, Lambay, and the Wicklow sea-coast, yield several rare and interesting species, some hardly to be found elsewhere in the British Islands.

To the student of animal distribution, Dublin appeals as the gateway into Ireland—a western outpost of the great Palæarctic Region. The fauna of Ireland is poor, when compared with the fauna of Britain, yet it is no mere attenuated remnant of the British fauna. In addition to many common animals—equally familiar around London or Inverness—Ireland contains representatives of two highly interesting faunistic groups: one northern, and the other south-western, in its affinities.¹ Many members of these groups are rare or unknown in Great Britain. It is in the west of Ireland that they are most strongly

¹ See R. F. SCHARRF, "European Animals," London, 1907 (ch. ii.), and G. H. CARPENTER, in "Ireland, Industrial and Agricultural," Dublin, 1902 (pp. 53–63).





Photo. N. H. Alcock.

Hairy-ARMED BATS (*Pterygites Leisleri*).
(From "Irish Naturalist," vol. viii.)

represented ; but several species of great interest have their headquarters along or near the eastern seaboard. For example, in pools high on the Dublin and Wicklow hills lives the northern water-beetle *Agabus arcticus* ; beneath stones in the mountain streams lurk colonies of the arctic and alpine springtail *Isotoma bidenticulata*. Along the coast sandhills, from North Dublin to the Boyne, may be found commonly the South European snail *Helix pisana* (fig. 11, p. 149), which inhabits also the south-western shores of England and Wales ; and from hedge-rows within four miles of the city may be beaten the Pyrenean weevil *Otiorrhynchus auropunctatus*, so far unknown in Great Britain or in Central Europe. Everywhere the naturalist finds evidence that Ireland is an older island than Great Britain, preserving for his study ancient elements of the great European fauna. The facts of distribution strongly suggest that the south-western element is more ancient than the northern, and that its members survived the Glacial Period in or near the area of the Ireland of to-day.

VERTEBRATA.

MAMMALS.

By C. B. MOFFAT, B.A.

The mammalian fauna presents few features of special interest. From the list of Dublin and Wicklow mammals, which was prepared by R. M. Barrington for the British Association Handbook for 1878, supplemented with the few additions that have since been made, it can be seen that the only Irish land mammals absent from the area are two species¹—the Lesser Horse-shoe Bat (*Rhinolophus hipposideros*, Bechs), and the Red Deer (*Cervus elaphus*, Linn.)—which in Ireland are now strictly confined to a few western counties. As might be expected, the larger species are scarce, and find their chief refuge in the wilder parts of Wicklow. On the other hand, a few interesting local varieties have come under attention near Dublin.

¹ Or three, if we allow specific rank to the little western Field-Mouse, *Mus celticus*, Barrett-Hamilton (Proc. Zool. Soc. Lond., 1900).

CHIROPTERA.

The Bats still need further attention, as it is probable that some, which are as yet only known from a few localities, may prove to be more general. Besides the Pipistrelle (*Pipistrellus pipistrellus*, Schreb.), and the Long-eared Bat (*Plecotus auritus*, Linn.), Leisler's, or the Hairy-armed Bat (*Pterygistes Leisleri*, Kuhl) is common in both counties. This species (Plate VII) apparently has its headquarters for the British Islands in the eastern half of Ireland, and is, perhaps, nowhere more abundant than about Dublin and Bray, particularly the latter locality. Two Bats which were not known for the Dublin and Wicklow area in 1878—Daubenton's (*Myotis Daubentonii*, Leisler) and the Whiskered (*M. mystacinus*, Leisler)—have since been proved to be at least locally resident, the former in Wicklow (near Bray) and the latter at two stations in County Dublin, including Lambay. On the other hand, Natterer's or the Reddish-grey Bat (*Myotis Nattereri*, Kuhl) is still, as when Barrington's list was prepared, represented by the solitary specimen procured at the Scalp (Wicklow) in 1845.

INSECTIVORA.

The Hedgehog (*Erinaceus europaeus*, Linn.) and the Lesser Shrew (*Sorex minutus*, Linn.), which are the only members of the order Insectivora found in Ireland, are common.

CARNIVORA.

The Fox (*Canis vulpes*, Linn.) has probably increased in rarity in non-hunting districts since 1878, and where preserved is not always free from the influence of imported blood. Scharff¹ recorded an occurrence of the rare form *melanogaster*, Bonap., in the adjoining County of Kildare. The specimen is in the Dublin Museum. But it should be remembered in reference to such varieties that the crossing which must sometimes take place between native

¹ Irish Naturalist, vol. v., 1896, p. 178.



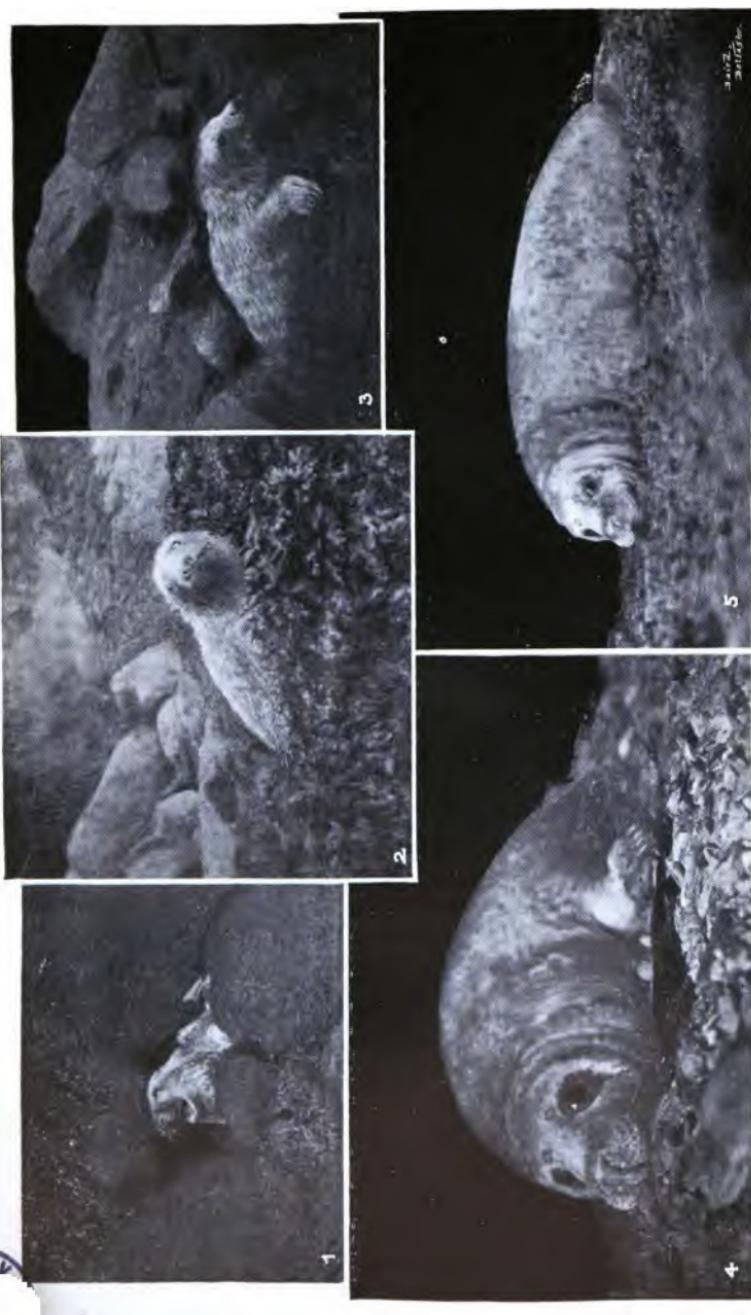


Photo. C. Baring-J.

From cave at Lambay.

YOUNG GREY SEALS (*Halichoerus grypus*).1, 2, and 3 were 2 ft. 6 in. long; 4 and 5 were 3 ft. 6 in., Oct. and Nov., 1906.
(From "Irish Naturalist," vol. xvi.)

and imported foxes is particularly likely to occur in the less wild eastern counties. The Pine Marten (*Mustela marten*, Linn.) is still found in the wooded parts of Wicklow, but no Dublin occurrence has been recorded since 1877, when—as stated in the Handbook for 1878—a specimen was obtained near Roundtown (Terenure). The Stoat, which is of the Irish form (*Putorius hibernicus*, Oldfield Thomas and Barrett-Hamilton) is common; and the Otter (*Lutra lutra*, Linn.) occurs on the rivers of both counties; but it is probable that the Badger (*Meles meles*, Linn.) has continued to lose ground since 1878, when it was described as “rare and local” in Wicklow, and “doubtfully resident” in Dublin.

As regards the marine Carnivora, the very interesting discovery has lately been made¹ that the Grey Seal (*Halichærus grypus*, Fab.)—which, as well as the Common Seal (*Phoca vitulina*, Linn.), has long been known to frequent the Dublin and Wicklow coasts—has a breeding haunt in the caves of Lambay (Plate VIII). This is the first and hitherto the only known breeding station of Grey Seals within the “Britannic” area which is not directly washed by the Atlantic Ocean.

RODENTIA.

The introduced Squirrel (*Sciurus vulgaris*, Linn.) has further extended its range since 1878, and is now nearly as well known throughout County Dublin as in County Wicklow. It is of the familiar British form, to which Oldfield Thomas would accord specific rank as *S. leucurus*, Kerr. The Field-Mice (*Mus sylvaticus*, Linn.) of this part of Ireland are found by Barrett-Hamilton to be of the normal type,² showing no approach to the small dark-coloured variety of the western counties. Among the sandhills of the North Bull in Dublin Bay, however, is found a very remarkable variety of the House-Mouse (*Mus musculus*, Linn.), to which attention was first

¹ Irish Naturalist, vol. xvi., p. 20.

² Proc. Zool. Soc. Lond., 1900, p. 403.

drawn in 1895 by H. Lyster Jameson.¹ These Mice are distinguished by a pale hue which harmonizes with their sandy surroundings ; and this instance of protective coloration possesses the greater interest, since the detached sandbank on which it has been developed is itself not more than about a hundred years old. Examples of the Black Rat (*Mus rattus*, Linn.) about Dublin are apparently very rare ; and the well-known black variety of the Common Rat (*Mus decumanus*, Pallas), to which Thompson gave the name of *hibernicus*, is of less frequent occurrence here than in some of the southern counties of Leinster. Of the Irish Hare (*Lepus timidus*, Linn.)—see Pl. IX—a light-coloured variety, on which Barrett-Hamilton bestows the subspecific name *lutescens*, has long been known to frequent the vicinity of Donabate, near the Dublin sea-coast, where the occurrence of such a form is perhaps analogous to that of the pale-coloured mice found on the North Bull. An attempt made by the late Lord Powerscourt, some forty years ago, to introduce English Hares (*Lepus europaeus*, Pallas) into his demesne in County Wicklow, of which an account was given in 1896,² does not appear to have met with more than temporary success. Our only other rodent is the Rabbit (*Lepus cuniculus*, L.), the Voles being unrepresented in Ireland.

CETACEA.

No new species has been added to the list of cetacean visitors to the Dublin and Wicklow coast which was drawn up by Barrington for the Handbook of 1878. This list included three Whales—the Common and Lesser Rorquals (*Balaenoptera musculus*, F. Cuv., and *B. rostrata*, Müll.), and the Bottle-nosed Whale (*Hyperoödon rostratus*, Gray). The Dublin Museum has since obtained the skull of a female of the last-named, which was stranded at Skerries in 1890. The Dolphins and Porpoises comprise

¹ Journ. Linn. Soc., Zool., vol. xxvi., pp. 465–473.

² Irish Naturalist, vol. vii., p. 73.



IRISH HARE (*Lepus timidus*) AND RED GROUSE (*Lagopus scoticus*).

Life-group in National Museum, Dublin.
(From Scharff's "European Animals.")





four species—the Common Porpoise (*Phocæna phocæna*, Linn.), Common Dolphin (*Delphinus delphis*, Linn.), White-beaked Dolphin (*Lagenorhynchus albirostris*, Gray), and Bottle-nosed Dolphin (*Tursiops tursio*, O. Fab.). There has been further corroboration since 1878 of the rarer species named above. Scharff¹ described in 1902 a remarkably large example of the White-beaked Dolphin (fig. 8), which had been captured in the last month of



FIG. 8.—White-beaked Dolphin (*Lagenorhynchus albirostris*), Howth, Co. Dublin. $\frac{3}{4}$ natural size. From Scharff, Irish Naturalist, vol. xi.

1901 at Howth—the scene of a former capture of the same species many years before; and three years later² was noticed the taking of two Bottled-nosed Dolphins—one of which was presented to the Dublin Museum—at the mouth of the Liffey, in April, 1905.

BIRDS.

BY RICHARD M. BARRINGTON, M.A., F.L.S.

The British Association Handbook of 1878 contained a list of 285 Birds, including some doubtful species; the present list contains only 145.

It has been thought desirable in this list to omit two classes of birds—i.e., those (60 in number) known to breed in every Irish county, and 41 which have not been observed

¹ Irish Naturalist, vol. xi., 1902, p. 66.

² Ibid., vol. xiv., p. 121.

since the last meeting of the British Association—thirty years ago—in the area under consideration.

The sixty Birds which nest in every county are the Mistle-Thrush, Song-Thrush, Blackbird, Stonechat, Red-breast, Whitethroat, Golden-crested Wren, Chiffchaff, Willow-Wren, Sedge-Warbler, Hedge-Sparrow, Long-tailed Tit, Great Tit, Coal Tit, Blue Tit, Wren, Tree-Creeper, Pied Wagtail, Grey Wagtail, Meadow-Pipit, Spotted-Flycatcher, Swallow, House-Martin, Sand-Martin, Greenfinch, Goldfinch, House-Sparrow, Chaffinch, Linnet, Bullfinch, Yellow Bunting, Reed-Bunting, Starling, Magpie, Jackdaw, Hooded Crow, Rook, Sky-Lark, Swift, Kingfisher, Cuckoo, Barn-Owl, Long-eared Owl, Sparrow-Hawk, Kestrel, Heron, Mallard, Teal, Ring-Dove, Grouse, Pheasant, Partridge, Corncrake, Water-Rail, Moor-Hen, Coot, Lapwing, Woodcock, Snipe, and Little Grebe.

The forty-one species included in the British Association Guide, 1878, and now omitted because they have not been observed in Dublin or Wicklow for thirty years, and for other reasons, are the White-tailed Eagle, Golden Oriole, Reed-Warbler, Marsh-Tit, Cirl-Bunting, Two-barred Crossbill, Water-Pipit, Rose-coloured Starling, Chough, Carrion Crow, Crested Lark, Purple Martin, Alpine Swift, Lesser Spotted Woodpecker, Belted Kingfisher, Yellow-billed Cuckoo, Marsh-Harrier, Goshawk, Honey-Buzzard, Hobby, Red-footed Falcon, Little Bittern, Spoonbill, Ferruginous Duck, King-Eider, Little Crake, Little Bustard, Kentish Plover, Great Snipe, Black-winged Stilt, Buff-breasted Sandpiper, Noddy Tern, White-winged Black Tern, Whiskered Tern, Sandwich Tern, Roseate Tern, Swift Tern, Little Gull, Bonaparte's Gull, Brünnich's Guillemot, Red-necked Grebe, Great Shearwater, and Fulmar. Two of the above, the Belted Kingfisher and Noddy Tern, should never have been included in any Irish, British, or even European list.

The Water-Pipit and Little Crake—not included in the previous British Association Guide—are also excluded here, because there is no recent record.

Most of the above are at the best rare stragglers; but there are three—the Chough, the Sandwich Tern, and the

beautiful Roseate Tern (said to nest in the district thirty years ago)—which have not only ceased to breed, but have not been recorded in either county since 1878. The White-tailed Eagle and the Marsh Harrier have also vanished from Dublin and Wicklow, and may soon disappear from Ireland. Though not yet gone, the Raven, Rock-Dove, Quail, and Black Guillemot nest less frequently, and the visits of the Golden Eagle to the Wicklow mountains are few and far between.

Nature is full of compensations, and if we have lost some, we have gained other birds: the Ring-Ouzel, Redstart, Whinchat, Grasshopper Warbler, Tree-Sparrow, Crossbill, Wood-Lark, Stock-Dove, Dunlin, and Common Tern can now be counted among our breeding species. This, in some instances, but not in all, may be due to more accurate observation.

The Siskin, Woodcock, and Arctic and Little Terns have extended their former breeding range. The Jay is inclined to spread; the Black Redstart is often recorded; the Tufted Duck occurs more frequently; the Starling, Rook, Jackdaw, and Herring Gull, and perhaps the Lapwing, are more plentiful: but no bird has increased so markedly as the Black-headed Gull. The Woodcock now breeds in every Irish county, and commences to pair in February. The close season should therefore be altered from March 1st to February 10th.

Lambay, under the fostering care of Mr. Baring, is now an island sanctuary: birds instead of dwindling have increased; and it would be an interesting experiment to attempt the re-establishment of the Chough in this island by introducing a few pairs from western Ireland.

The introduction of the Black Grouse into Wicklow was unsuccessfully attempted several years ago by the late Viscount Powerscourt.

Interesting birds which breed in every Irish county are the Long-tailed Tit, Tree-Creeper, Long-eared Owl, Water-Rail, Woodcock, and Kingfisher. A skilled ornithologist might easily fail to find a single nest of any one of these birds during a day's excursion, for though the species are widespread, individuals are not numerous, and protective

coloration and the nature of their haunts assist concealment.

Since 1878 four birds have occurred in Dublin or Wicklow which are additions to the Irish avi-fauna—i.e., Richard's Pipit (*Anthus richardii*), Serin Finch (*Serinus hortulanus*), Lesser Kestrel (*Falco cenchris*), Wood Sandpiper (*Totanus glareola*) ; also the following, not previously recorded from either county—Barred Warbler, Lapland Bunting, Wryneck, Surf Scoter, Stock-Dove (breeding), Pallas's Sand Grouse, and Spotted Redshank.

RESTRICTED LIST (see p. 118).

Redwing. *Turdus iliacus*.—Regular winter visitor, arriving in October and departing in March. Common.

Fieldfare. *Turdus pilaris*.—Regular winter visitor, arriving in November and departing in April. More frequent in open and exposed localities than the Redwing.

Ring Ouzel. *Turdus torquatus*.—Summer visitor, arriving in April, and departing about September. Breeds on and near the mountains. Frequent.

Wheatear. *Saxicola axanthe*.—Summer visitor, the earliest to arrive. Remains March to September. Common on the coasts and mountains.

Whinchat. *Pratincola rubetra*.—Summer visitor, May to October. Breeds locally and chiefly within two or three miles of the coast. Frequent. Immature birds always about Bald Doyle in August and September. (W. Williams.)

Redstart. *Ruticilla phoenicurus*.—Summer visitor, from end of April to beginning of September. Frequently killed striking Rockabill Lighthouse lantern. First detected breeding in Ireland in 1885 at Powerscourt, and since then found nesting at Luggela, County Wicklow, and in County Tyrone. It will probably be found breeding in other Irish counties, judging by numbers killed at lighthouses.

Black Redstart. *Ruticilla titys*.—Winter visitor, late October to March. One or two occur almost every winter along the coast. It attracts attention by its reddish tail. Frequently obtained at lighthouses.

Blackcap. *Sylvia atricapilla*.—Summer visitor, end of

April to October, and a few may remain all winter. Obtained more frequently at lighthouses in autumn than spring. Commoner in County Wicklow than in County Dublin.

Garden Warbler. *Sylvia hortensis*.—Rare summer visitor. The nest has not yet been found in Dublin or Wicklow, though the bird has been observed when probably on its passage to the Shannon valley, where it is known to breed annually. Seldom taken at light-stations.

Barred Warbler. *Sylvia nisoria*.—Very rare straggler. Has once occurred at Rockabill Light-station, September 25th, 1896.

Wood Wren. *Phylloscopus sibilatrix*.—Rare summer visitor, chiefly to County Wicklow, where it possibly breeds, but this supposition has not yet been confirmed by actual observation.

Icterine Warbler. *Hypolais icterina*.—Very rare straggler. Has occurred once, and possibly twice, but not recently.

Grasshopper Warbler. *Locustella naevia*.—Summer visitor, end of April to August. Possibly frequent; but owing to its shy, skulking habits, is seldom seen. Its note has been compared to the chirp of a grasshopper, but it resembles more closely the sound of a fisherman's reel.

Dipper. *Cinclus aquaticus*.—Common, and resident along rapid streams. After the great Bray flood of August, 1905, it almost vanished from the Glencullen and Dargle rivers, but has now returned.

White Wagtail. *Motacilla alba*.—This species resembles the Pied Wagtail (*M. lugubris*); and it may often escape attention during the last week in April and the first week in May, during which period it annually moves northward on migration along our west coast in some numbers.¹

Yellow Wagtail. *Motacilla Raii*.—Rare summer visitor on passage. Has once nested in County Dublin (E. Williams). Said to occur every autumn at Baldoyle.

Richard's Pipit. *Anthus Richardi*.—The first Irish

¹ Irish Naturalist, vol. xii., p. 300.

specimen of this long-legged Pipit was captured by a bird-catcher at Lucan, November 22nd, 1907.

Rock-Pipit. *Anthus obscurus*.—Resident, and breeds along the coast. Less common than in western Ireland.

Great Grey Shrike. *Lanius excubitor*.—Has occurred about five times in County Dublin since 1820; not recorded from Wicklow. Omitted from Brit. Assoc. Handbook, 1878.

Waxwing. *Ampelis garrulus*.—Rare and uncertain winter visitor; only three records during past fifty years—one at Blessington, 1882; one at Delgany, 1898; and one at Stamullen, County Meath, also in 1893 (E. Williams).

Hawfinch. *Coccothraustes vulgaris*.—An irregular winter visitor to the Phoenix Park. It disappeared for about twelve years, but reappeared in 1888, and has occasionally been observed since.

Siskin. *Carduelis spinus*.—Many breed in Wicklow, and there is an immigration into both counties at the end of October.

Serin. *Serinus hortulanus*.—Very rare straggler. Has twice occurred in County Dublin—1898 and 1907—but not elsewhere in Ireland.

Tree Sparrow. *Passer montanus*.—Resident in County Dublin, and has occurred in Wicklow. Breeds on northern portion of Dublin coast, but not seen in winter at Balbriggan (Benson).

Brambling. *Fringilla montifringilla*.—Winter visitor, November to April. More plentiful in hard winters.

Lesser Redpoll. *Linota rufescens*.—Resident. Breeds in both counties. Gregarious in winter. Never received from any light-station.

Twite. *Linota flavirostris*.—Resident; also an autumnal immigrant. Breeds in the wilder parts of both counties.

Crossbill. *Loxia curvirostra*.—Resident. Breeds in Wicklow, and is believed to do so every year. Irregular autumnal immigrant. Has once occurred at a lightship.

Corn-Bunting. *Emberiza miliaria*.—Resident, and found chiefly near the coast. Less common than in many other parts of Ireland. Has never been killed striking at light-stations.

Lapland-Bunting. *Calcarius lapponicus*.—Very rare

straggler. Has twice occurred in County Dublin, January 27th, 1907,¹ and December 12th, 1907. On both occasions captured by bird-catchers.

Snow-Bunting. *Plectrophenax nivalis*.—Winter visitor, November to April, in varying numbers, chiefly to the coast, where it is usually observed in hard weather.

Jay. *Garrulus glandarius*.—A resident and an increasing species in some Irish counties, wandering occasionally into Wicklow, and possibly into Dublin, but not known with certainty to have nested in either county.

Raven. *Corvus corax*.—Rare and decreasing species. Used to breed at Howth (Hart) and on Lambay. A few pairs still nest in the Wicklow mountains.

Wood-Lark. *Alauda arborea*.—Rare and very local. The nest was found near Ovoca, Wicklow, in 1894. This is the only authentic instance of its having bred in Ireland, though it may have done so in other counties.

Nightjar. *Caprimulgus europaeus*.—Regular summer visitor; May to August. Breeds in both counties.

Wryneck. *Lynx torquilla*.—Very rare straggler. Occurred in Wicklow, May, 1895, and at Rockabill Lighthouse, 1896.

Great Spotted Woodpecker. *Dendrocopos major*.—Rare visitor. Has occurred twice in each county (Ussher).

Bee-eater. *Merops apiaster*.—Rare visitor. One shot at Balbriggan, May, 1889. Six seen and one shot at Delgany, November, 1892.

Hoopoe. *Upupa epops*.—Rare spring and autumn visitor. Has occurred on three or four occasions in each county within the past twenty-five years.

Short-eared Owl. *Asio accipitrinus*.—Winter visitor. The bulk arrive early in November simultaneously with the woodcock. A great immigration took place in 1907, in the autumn of which year rats were very numerous in Ireland.

Snowy Owl. *Nyctea scandiaca*.—Very rare winter visitor. Has twice occurred in County Dublin.

Montagu's Harrier. *Circus cineraceus*.—Has been obtained in 1848, 1849, 1874, 1890, 1893 (two), 1899 (three), and 1907, and on every occasion save one in

¹ Irish Naturalist, vol. xv., 1906, p. 112.

Wicklow, or on the borders of that county. Possibly breeds in Wicklow.

Hen-Harrier. *Circus cyaneus*.—Rare straggler, decreasing. Last obtained in 1894 at Glenasmole (E. Williams).

Buzzard. *Buteo vulgaris*.—Rare straggler. There are only four records from the two counties within the past thirty years.

Rough-legged Buzzard. *Buteo lagopus*.—Has twice occurred in Wicklow, 1897 and December 9th, 1906.

Golden Eagle. *Aquila chrysaëtus*.—Approaching extinction in Ireland. Three or four have straggled to the Wicklow mountains during the past twenty years.

Peregrine. *Falco peregrinus*.—Resident; a few pairs breed on the sea-cliffs of Dublin and in the higher Wicklow mountains. This species appears to be holding its own.

Merlin. *Falco aeralon*.—Resident. More frequent in Wicklow than Dublin. Three nests in one year on Kippure.

Lesser Kestrel. *Falco cenchris*.—The only Irish specimen was obtained at Shankill, County Dublin, February, 1891.

Osprey. *Pandion haliaëtus*.—Has occurred on three occasions, once at Glendalough, Wicklow, 1898, and twice in County Dublin, 1889 and 1881.

Cormorant. *Phalacrocorax carbo*.—A few breed on Lambay¹; not now on Ireland's Eye (W. Williams); more plentiful from October to April.

Shag, or Green Cormorant. *Phalacrocorax graculus*.—Some breed on Lambay. More numerous in the West and North of Ireland.

Gannet. *Sula bassana*.—Seen chiefly in the months of March, April, May, and October. Usually passing northwards in spring. Movement less decided in autumn. Rare in December. The only Irish breeding-stations are the Skelligs and the Bull Rock in Kerry. 15,000 to 20,000 now breed on the former.

Night Heron. *Nycticorax griseus*.—Rare and irregular visitor, and usually in immature plumage. Has occurred in Dublin in 1865, 1876, and 1888, in autumn and winter.

Bittern. *Botaurus stellaris*.—Very rare visitor. Extinct as a breeding species in Ireland.

¹ H. C. HART, "Birds of Lambay," *Zoologist*, 1883.

Glossy Ibis. *Plegadis falcinellus*.—Very rare visitor. Has occurred in autumn in County Dublin, 1840, 1864, and 1906.

Grey Lag Goose. *Anser cinereus*.—Regular winter visitor to marshy land at Kilcoole, Wicklow, some remaining until May. Rare in County Dublin.

White-fronted Goose. *Anser albifrons*.—Regular winter visitor. Perhaps scarcer but less local than the Grey Lag and Brent Geese in Dublin and Wicklow. This is the common "wild goose" of Ireland.

Bean-Goose. *Anser segetum*.—Possibly has occurred, but no specimen appears to have been obtained in either county. The distribution of this species in Ireland requires investigation.

Bernacle Goose. *Bernicla leucopsis*.—Rare winter visitor. More frequent in north-western Ireland.

Brent-Goose. *Bernicla brenta*.—Probably the commonest wild goose on the Dublin coast. May occasionally be seen feeding on the slob near the tram-line at Clontarf. Apparently uncommon in Wicklow.

Whooper Swan. *Cygnus musicus*.—Irregular winter visitor in small numbers. Twelve seen and two shot at Malahide, 1889. No Wicklow record.

Bewick's Swan. *Cygnus Bewicki*.—The small flocks and stragglers seen in severe winters are probably of this species, but it is seldom shot. Occurs every winter in the west of Ireland. The mute or tame Swan has sometimes been mistaken for it.

Sheld-Duck. *Tadorna cornuta*.—This handsome species is resident, and breeds regularly at Portmarnock, Ireland's Eye, and Sutton in small numbers (W. Williams). Occurs in flocks in Dublin Bay in October. Possibly breeds in sandhills on Wicklow coast.

Ruddy Sheld-Duck. *Tadorna casarca*.—Five seen in June, 1892. A pair at Beechwood, Malahide, May, 1907. Occasionally kept in semi-captivity.

Gadwall. *Anas strepera*.—Rare winter visitor. Six Dublin records; the last at Balbriggan, February, 1907 (W. Williams).

Shoveler. *Spatula clypeata*.—Common winter visitor,

and possibly resident and breeding. Seen at Brickfields, Portmarnock, all summer (H. B. Rathbone).

Pintail. *Dafila acuta*.—Winter visitor, in small numbers.

Garganey. *Querquedula circia*.—Very rare visitor. Has occurred once in Wicklow and on four occasions in Dublin, the last being May, 1888 (Templer).

Wigeon. *Mareca penelope*.—Plentiful in winter, especially about Malahide and Rogerstown estuaries, where large numbers are shot for the Dublin market. There are no such favourite feeding-grounds on the Wicklow coast.

Pochard. *Fuligula ferina*.—Frequent in winter. Is stated to have bred in Ireland, but there is no absolute proof. The famous Canvas-back duck of America belongs to this genus.

Tufted Duck. *Fuligula cristata*.—Winter visitor. Recently found breeding in several Irish counties, and may possibly breed in County Dublin.

Scaup. *Fuligula marila*.—Winter visitor to the coast, in small numbers; most frequent in February and March (Cox).

Golden-eye. *Clangula glaucion*.—Winter visitor, occurring on both salt and fresh water. More frequent in Dublin Bay in March and April (Cox).

Long-tailed Duck. *Harelda glacialis*.—Irregular winter visitor, in small numbers, chiefly obtained in hard weather. Rarely occurs inland. The long tail is held almost erect when swimming.

Eider Duck. *Somateria mollissima*.—Rare straggler in winter, obtained on four occasions in County Dublin. Last in January, 1903, at Malahide.¹

Scoter. *Edemia nigra*.—Visits the coast annually in winter, but keeps out to sea. One of the few ducks which have been killed striking lighthouse lanterns. Was found nesting in Ireland in 1905.

Velvet Scoter. *Edemia fusca*.—Rare winter straggler. Has occurred five times in County Dublin, on the last occasion in 1881.

Surf-Scoter. *Edemia perspicillata*.—A single specimen was obtained in October, 1880, by Mr. Hanks at Clontarf.

¹ *Irish Naturalist*, vol. xii., 1903, p. 112.

Goosander. *Mergus merganser*.—Winter visitor; one to three occasionally seen in December and January.

Red-breasted Merganser. *Mergus serrator*.—Frequents the estuaries in winter in small numbers. Breeds in several Irish counties.

Smew. *Mergus albellus*.—Rare winter visitor to Ireland. No specimen appears to have been recently obtained in either county.

Stock-Dove. *Columba oenas*.—A species first observed in Ireland in 1875, and now extending its range. Obtained in Wicklow, 1889 (Patten). Breeds at Powerscourt, Luggela, and Glendalough, and is believed to breed at Howth. A pair were seen to enter a rabbit-hole at "the Island," Malahide, June, 1904 (W. Williams).

Rock-Dove. *Columba livia*.—Formerly bred at Howth and Lambay; but there is no evidence of its having done so recently. Is stated to breed on the Wicklow coast.

Turtle-Dove. *Turtur communis*.—A summer visitor, in very small numbers; generally observed in May, June, and September. There is no authentic record of its nesting in Ireland.

Pallas's Sand-Grouse. *Syrrhaptes paradoxus*.—This interesting Asiatic species occurred in Ireland in 1868 and 1888. On the last occasion about fifteen frequented the sand-hills at Portmarnock for about six weeks.

Quail. *Coturnix communis*.—Formerly plentiful, and a regular summer visitor, but now almost a rare bird. Has bred in County Dublin in 1891 and 1896. Heard at Fassaroe, County Wicklow, in 1898, and at Balbriggan, 1908, 1905,¹ and 1907 (Benson). Its note has been mistaken for that of a young turkey.

Spotted Crake. *Porzana marueta*.—Rare visitor, chiefly in autumn. Has occurred once in Wicklow, and four times in County Dublin. Last record, November 25th, 1906 (W. Williams).

Stone-Curlew. *Oedicnemus scolopax*.—Has occurred on six occasions on Dublin coast; always in November, December, or January. Last seen, December 10th, 1900 (Patten). No Wicklow record.

¹ Irish Naturalist, vol. xiv., 1905, p. 164.

Golden Plover. *Charadrius pluvialis*.—Resident; breeds on the boggy slopes of the high mountains in Wicklow, about Sally Gap, &c., and possibly in County Dublin. Gregarious in winter. Large flocks may be almost daily seen on the Murrough of Wicklow during the greater part of winter and early spring.

Grey Plover. *Squatarola helvetica*.—Annual winter visitor; confined to the coast. Rarely seen in flocks. Readily distinguished from the Golden Plover by a small but distinct hind toe.

Ringed Plover. *Aegialites hiaticola*.—Resident and common. More numerous in winter; a few breed.

Turnstone. *Strepsilas interpres*.—Annual autumn and winter visitor to the coast; loves a rocky shore. A few remain all summer. One was shot on July 18th, 1900, and forty were seen on July 4th of the same year.¹

Oyster-catcher. *Hæmatopus ostralegus*.—Resident and common; gregarious in winter, when it becomes more numerous. A few breed.

Avocet. *Recurvirostra avocetta*.—Has occurred twice on the Dublin coast, the last occasion being October, 1897.

Grey Phalarope. *Phalaropus fulicarius*.—Occasional winter visitor; generally observed in hard or stormy weather.

Jack Snipe. *Gallinago gallinula*.—Regular winter visitor. Has been killed striking at light-stations, and most frequently on south and south-east coasts.

Dunlin. *Tringa alpina*.—A regular winter visitor, arriving on the coast in large numbers in October. A few breed. The nest has been found in Wicklow.

Little Stint. *Tringa minuta*.—Autumn visitor, in small numbers, to the Dublin coast; usually seen in September, and does not remain long.

Curlew-Sandpiper. *Tringa subarquata*.—Visits the shores of Dublin Bay somewhat irregularly and in small numbers in September.

Purple Sandpiper. *Tringa striata*.—Regular winter visitor; occurring singly or in pairs, chiefly in November, and again in April, on the return journey. Loves a rocky shore.

¹ C. J. PATTEN, "Aquatic Birds," pp. 242-3.

Knot. *Tringa canutus*.—Common winter visitor to the mud-flats north of Dublin; also seen on the Wicklow coast. Most plentiful in October, when Knots collect in large flocks.

Sanderling. *Calidris arenaria*.—Regular visitor, in small numbers, to sandy shores. Chiefly seen in September and May on passage.

Ruff. *Machetes pugnax*.—Rare visitor. Has occurred on ten occasions on the Dublin and three on the Wicklow coast, chiefly in September.

Sandpiper. *Totanus hypoleucus*.—Summer visitor, arriving early in May. Some depart at the end of July. They are seldom seen late in autumn.

Wood-Sandpiper. *Totanus glareola*.—Rare and irregular straggler in August. First obtained in Ireland at Calary Bog, County Wicklow, in 1885; seen again in same locality, 1896, when two were shot.¹ Another killed at Bald Doyle, County Dublin, 1901.

Green Sandpiper. *Totanus ochropus*.—Rare, but perhaps regular annual visitor, August to February, both at marine and inland stations. No Wicklow record.

Redshank. *Totanus calidris*.—Resident and common in suitable localities. Scatters inland to breed in April, and becomes gregarious on the coast in autumn.

Spotted Redshank. *Totanus fuscus*.—Very rare visitor. Has occurred six times on the Dublin coast in the autumn. Last record, 1894.

Greenshank. *Totanus canescens*.—Regular autumn visitor. Usually in small numbers. A few have been observed in June and even in July. These are more probably non-breeding birds which have lagged behind, rather than early arrivals from the north after the nesting season is over. The species does not breed in Ireland.

Bar-tailed Godwit. *Limosa lapponica*.—Regular autumn visitor, increasing in numbers from August to November, when large flocks are seen. A few non-breeding birds remain until June. Has been killed striking light-stations.

Black-tailed Godwit. *Limosa Belgica*.—Occasional

¹ Irish Naturalist, vol. x., p. 205.

visitor, chiefly in August and September, and much rarer than the last species. There are nine Dublin records and one for Wicklow.

Curlew. *Numenius arquata*.—Resident and plentiful on the coast. Breeds in the mountain bogs of Wicklow, and perhaps sparingly in Co. Dublin. The migratory movement northward in spring passes up the east coast of Ireland, chiefly in March.

Whimbrel or May-Bird. *Numenius phaeopus*.—A bird of well-marked double passage. When going northward in May, its cries may be heard over the city, especially on dark nights. Unlike the Curlew, it prefers the west to the east coast on its northward journey. Returns southward in August.

Black Tern. *Hydrochelidon nigra*.—Rare straggler. Has occurred on eleven occasions in Dublin.

Common Tern. *Sterna fluviatilis*.—Regular summer visitor, arriving in May and leaving in August and September. Breeds in small numbers at Skerries and Malahide (G. C. May).

Arctic Tern. *Sterna macrura*.—Regular summer visitor, apparently arriving and departing with the Common Tern, but more numerous (A. G. More). Said to breed on "the Island," Malahide.

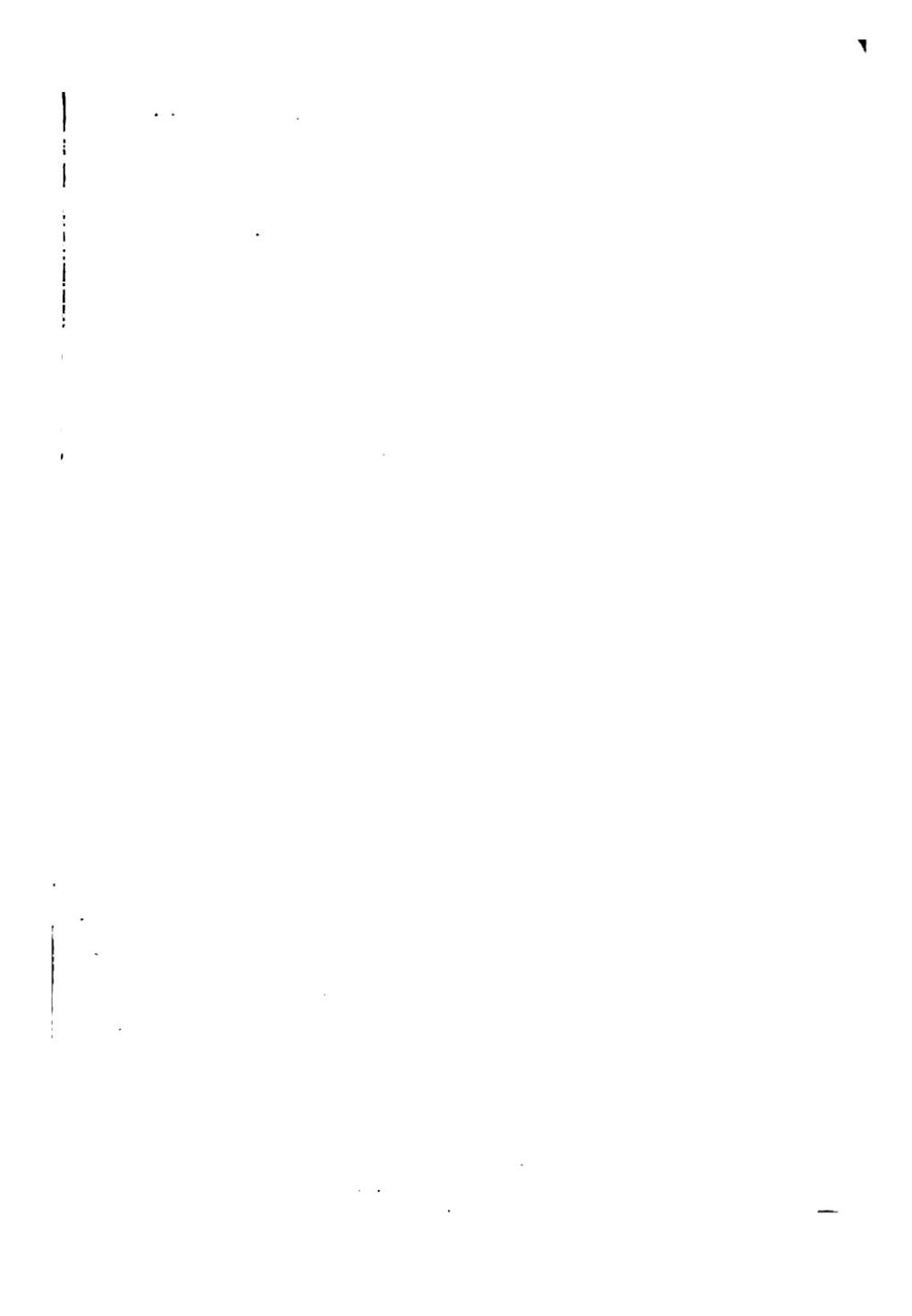
Little Tern. *Sterna minuta*.—Regular summer visitor to the coast, arriving in May. Breeds in several localities on the Dublin and Wicklow coasts. An increasing species. Departs in September.

Sabine's Gull. *Xema Sabinii*.—Has occurred on seven occasions on the Dublin coast, chiefly in September. The last record is in 1884.

Black-headed Gull. *Larus ridibundus*.—Resident and common at all seasons. Has greatly increased of late years. Large colonies breed in the midland counties. Numbers follow the plough in winter in search of worms.

Common Gull. *Larus canus*.—Resident and more frequent in winter. Breeds in north and west of Ireland.

Herring-Gull. *Larus argentatus*.—Resident, and the commonest Gull on the coasts at all seasons. Many breed on Lambay and a few on Ireland's Eye. Like the Black-





KITTIWAKES NESTING ON LAMBAY.

(From "Irish Naturalist," vol. xvi.)

Photo. G. E. Low.

G.H.
—

headed and Common Gull, it often follows the plough in winter.

Lesser Black-backed Gull. *Larus fuscus*.—A few breed on Lambay. Migrates southward in autumn. Very rare in winter, common in April.

Great Black-backed Gull. *Larus marinus*.—Usually seen singly or in pairs, and rarely or never in flocks. Occurs at all seasons. Two pairs breed on Lambay, and one pair on Ireland's Eye (W. Williams). Feeds on small rabbits as well as fish.

Glaucous Gull. *Larus glaucus*.—This northern species is a rare winter visitor, and usually seen in January or February. Occurs singly, and almost always immature.

Iceland Gull. *Larus leucopterus*.—Very rare winter visitor, chiefly obtained December to February. Like the Glaucous Gull, occurs singly and in immature plumage.

Kittiwake Gull. *Rissa tridactyla*.—Very common in summer. Rather rare in winter. Begins to arrive about the middle of March. Seldom seen inland. Breeds on Lambay (Plate X) and Ireland's Eye.

Great Skua. *Megalestris catarrhactes*.—Very rare visitor. Has occurred July, 1888, November, 1886, and October, 1880. These are all County Dublin records.

Pomatorhine Skua. *Stercorarius pomatorhinus*.—Rare visitor when on migration southwards, and chiefly in October.

Richardson's Skua. *Stercorarius crepidatus*.—Seen almost every autumn in September or October on migration southwards.

Long-tailed Skua. *Stercorarius parasiticus*.—Rare and uncertain autumnal visitor. Like all the Skuas, approaching land more frequently in bad weather.

Razorbill. *Alca torda*.—Common. Breeds on Lambay and in small numbers on Ireland's Eye. Although it leaves its breeding station in the autumn at or about the same time as the next species, it is said to arrive a month later in spring.¹ A few remain all the winter.

¹ See R. M. BARRINGTON, "Migration of Birds at Irish Light-Stations," pp. 243-4.

Gull-met. *Larus tridactylus*.—Common. Breeds on Lambay, rare in winter.

Black Gull-met. *Larus pygmaeus*.—A few breed on Lambay, Ireland's Eye, and Bray Head.—Decreasing. Occasionally obtained in winter.

Little Auk. *Morpha alba*.—Rare. Single specimens of the arctic breeding species are occasionally obtained in winter.

Puffin. *Fregata arctica*.—Many breed on Lambay and a few on Ireland's Eye, but the numbers are small compared with the enormous colony on the Saltees, County Wexford (Plate XI). Arrives at the end of March, and leaves in August. Rare in winter.

Great Northern Diver. *Columbus glaucescens*.—Frequent visitor, more numerous in early spring when on its way northwards.

Black-throated Diver. *Columbus niger*.—Very rare visitor. Much less frequent than the Great Northern Black-throated Diver.

Red-throated Diver. *Columbus septentrionalis*.—Frequent in winter. More plentiful in April (Cox). The commonest of the three Divers.

Great Crested Grebe. *Podiceps cristatus*.—Very rare visitor in winter. Breeds in at least fifteen Irish counties (Hester), but not in Dublin or Wicklow.

Minnowish Grebe. *Podiceps auritus*.—Rare winter visitor in salt water.

Great Crested Grebe. *Podiceps nigricollis*.—Very rare visitor. Found, June, 1847, and October, 1899.

Storm Petrel. *Procellaria pelagica*.—Only two records. One seen on the Liffey, near the Custom House, 1894 (Hawkins). Probably a few occur off the coast, on passage in autumn.

Dark-tailed Petrel. *Oceanodroma leucorrhoa*.—Not so difficult to identify this petrel as a breeding species as the Storm Petrel, when compared with the Storm Petrel. The last ten autumn records of its occurrence, nine from Dublin and one in Wicklow, against two of the Storm Petrel. This species seems to have been blown

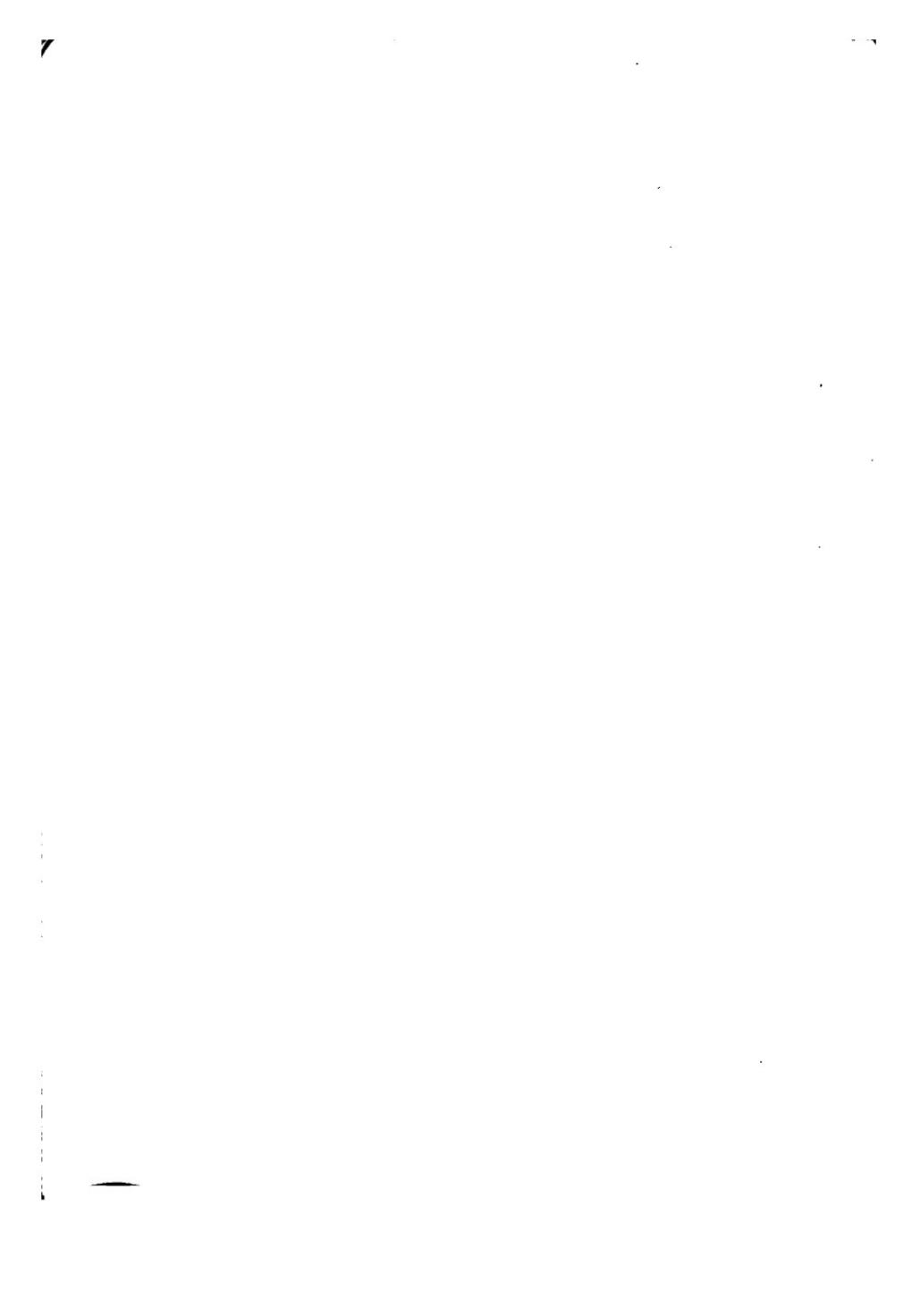
PLATE XI.

[To face page 128.]



COLONY OF PUFFINS, SALTREE ISLANDS, CO. WEXFORD.
(From a photograph by Geo. E. Low.)





right across Ireland in the great westerly gales in the autumn of 1891 (Ussher).

Manx Shearwater. *Puffinus anglorum*.—Arrives in March and leaves in September. Practically absent in southern waters during November, December, and January. Some breed on Lambay, and a few on Ireland's Eye and Bray Head.

The additions to our knowledge of the Irish avi-fauna within the past thirty years have been many. Observers are more numerous, and the printed and ms. literature of the subject has been admirably sifted, condensed, and then presented to the public in the now standard text-book on "The Birds of Ireland" (1900), by R. J. Ussher and Robert Warren, which has superseded the older but at the time (1850) excellent work of Thompson, and the small volume of Watters (1853). The list of Irish Birds prepared by the late A. G. More, a second edition of which was published in 1890, gives, in a few lines under each species, the considered opinion of one of the most cautious and reliable Irish naturalists of the last century.

Mr. R. J. Ussher and Mr. C. B. Moffat have greatly assisted in the preparation of the above list; and Mr. W. Williams, Dr. Patten, and the Rev. Dr. Benson have supplied notes.

For further information, readers should refer to Cox, "Birds of Dublin and Wicklow" (Zoologist, 1879).—HART, "Birds of Lambay" (Zoologist, 1883).—USSHER and WARREN'S "Birds of Ireland" (1900).—BARRINGTON, "Migration of Birds as observed at Irish Light-Stations" (1900).—PATTEN'S "Aquatic Birds of Great Britain and Ireland" (1906); and The Irish Naturalist (1892-1908).

REPTILES AND AMPHIBIANS.

By R. F. SCHARFF, PH.D., M.R.I.A.

These groups were apparently thought of so little importance during the meeting of the British Association in 1878 that they were entirely omitted from the formal list of the County Dublin fauna. Yet, though very few in number, the species belonging to these classes are of sufficient interest to deserve recognition. Their very poverty in Ireland is a noteworthy fact.

Ireland possesses only a single Reptile—the Viviparous Lizard (*Lacerta vivipara*). Though nowhere common, it is widely distributed over the country, and County Dublin forms no exception. It has been noticed on the promontory of Howth, near Malahide, and near Bray; and no doubt it occurs in other localities in the county. The remarkable feature in the reptilian fauna of Ireland is that snakes are entirely absent.

Of Amphibians only three species inhabit Ireland, one of which, the Natterjack Toad (*Bufo calamita*), does not come within the scope of this Guide, since it is confined to a very limited area on the south-west coast. Of the other two one is a Newt, *Molge vulgaris*, and the other the Common Frog (*Rana temporaria*).

No one has ever expressed any doubts as to the claims of the Newt to be considered indigenous to Ireland. It is found in every suitable locality in County Dublin. As for the Frog, it was generally regarded as an introduced species until doubts were cast upon this belief in an article published in 1898.¹

This assumption largely rests on a passage referring to Ireland and written in the ninth century by St. Donatus, of which the following lines are a translation:—

“No savag^e bear with lawless fury roves,
No raging lion through her sacred groves;
No poison there infects, no scaly snake
Creeps through the grass, no croaking frog annoys the lake.”

¹ R. F. SCHARFF, “Is the Frog a Native of Ireland?”—Irish Naturalist, vol. ii., 1893, pp.1-6.

It is also asserted that one of the Fellows of Trinity College in the year 1699 placed frog-spawn in a ditch in the College Park, whence the species is supposed to have spread all over Ireland. Yet even William Thompson, in his "Natural History of Ireland," alludes to the historic record of a frog having been seen in a pasture-field near Waterford about the year 1680, nearly seventy years before its supposed introduction in County Dublin. But we possess a still earlier record. Giraldus, when acting as secretary to Prince John, son of King Henry II, notes in his famous book on Ireland, written in the year 1187, that a frog was found in a meadow near Waterford, and was informed that such a thing had never happened before. The author, being of a speculative turn of mind, and a thorough believer in artificial introductions, said, "It may have happened that some particle of the germ (from which Frogs are bred) hid in the moist soil, had been exhaled into the clouds by the heat of the atmosphere, and wafted hither by the force of the winds, or perhaps, that the embryo reptile had been swept into the hollow of a descending cloud, and being by chance deposited there, was lodged in an inhospitable and uncongenial soil."

The occurrence may also be explained by the hypothesis that the ancient Irish, for some reason or other, wished to deny the existence in Ireland of a supposed venomous creature such as a frog; possibly in order to keep up the tradition that no such animal could live in the country. Within the last few years the subject has been discussed by many Irish naturalists; and it has been shown that the remains of this Amphibian are intimately associated in various Irish cave-deposits with the bones of extinct mammals. Even this discovery, however, has not altogether satisfied those who tenaciously cling to ancient traditions, for they urge that frogs might have burrowed into the soil of the caves, and thus left their remains in the deposits.

FISHES AND CYCLOSTOMES.

BY G. P. FARREN, B.A.

In the following notes only the more interesting or important Fishes which occur in the Dublin district are dealt with. It is probable that the materials for a complete list are not yet available, as several of the commoner littoral and shallow-water species have not yet been recorded with certainty.

It may be well to describe briefly the district in question, since the distribution of the Fish fauna in any area depends mainly on the nature of the sea-floor. In the area of the Irish Sea adjoining the county of Dublin we find almost every type of bottom. The rocky coast-lines of Dalkey, Howth, and the shore adjacent to Lambay alternate with the sandy stretches of Dublin Bay, Portmarnock and Skerries Bay. Northwards from Dalkey there runs a broad band of sand from five to eight miles in width, as far as Dundalk Bay. Outside the sandy ground, to the N.-E. of Lambay, lies the great mud area of the Irish Sea; while to the south of Lambay the coarse sand and shelly gravels in the deeper water pass gradually into the finer sand adjoining the coast. There are two shallow banks lying parallel to, and a short distance from, the shore. One of these, the Burford Bank, lies directly across the mouth of Dublin Bay; the other, the Kish Bank, with its northern prolongation, the Bennet Bank, is about three miles outside the Burford Bank, and forms the first of a long series of banks which stretches southwards as far as the Tuskar, County Wexford.

The number of permanent inhabitants of, or regular visitors to, the Dublin coast is comparatively small. The family of the Sparidæ, which in the British list is credited with some seven or eight species, has only one representative, the Sea Bream (*Pagellus centrodontus*), the other British species being southern forms, whose range does not extend so far north. The Bass (*Labrax lupus*) and the Grey Mullet (*Mugil chelo*) are frequently taken close to shore,

the latter being sometimes palmed off on the unwary as White-Trout or "Rock-Salmon" by itinerant vendors.

Of the Gurnards the most plentiful is the Noud or Grey Gurnard (*Trigia gurnardus*), the Red and Sapphirine Gurnards (*T. culeus* and *T. hirundo*) being much less abundant, though still common. The Streaked Gurnard has been found off Carlingford, and probably occurs on the Dublin coast.

The Mackerel and Horse Mackerel must both be regarded as regular visitors which do not breed in the district. The Mackerel fishery is of considerable local importance, fish to the value of over £1000 having been landed on the Dublin coast in 1905. The fish are found on the coast from August onwards. They are not full-grown, and are known as "Autumn" or "Harvest" Mackerel, as dis-

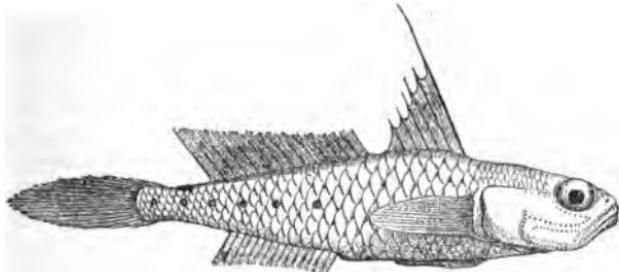


FIG. 9.—*Gobius Friesi*. After Scharff, Proc. R.I.A. (3), vol. i.

tinguished from the larger spawning or "Spring" Mackerel which visit the south and west coasts of Ireland earlier in the year.

The Gobiidae are for the most part shore fishes, but there are two rather interesting deep-water species which inhabit in some numbers the mud area to the north of the district. One of these, *Gobius Friesi* (fig. 9), is a typical Goby in form, but is remarkably coloured, the ground-colour being a dirty white with a few small yellow spots on the fins and body. It long escaped notice as a British fish. The other, *Callionymus maculatus*, the Lesser Dragonet, was formerly regarded as one of the rarer British fishes;

but since its proper habitat has been discovered it can no longer claim that distinction. The Crystal Goby (*Crystallogobius Nilssonii*), a fish of about 1½ inches in length and perfectly transparent, except for its eyes, occurs all through the district, and is probably of some importance as a food for other fishes.

The Angler-fish (*Lophius piscatorius*), locally known as the Mullagoon, is very common throughout the district, and sometimes reaches an immense size on a muddy bottom in deep water. It is in Ireland generally regarded as offal, even by persons who appreciate Skate and Ray; but its value as a food-fish is admitted by all who have made trial of it.

The Cod family are well represented. Cod, Haddock, and Whiting are fished for by the trawlers supplying the Dublin market, Haddock being especially plentiful on the grounds to the north of the Kish Lightship. Pollock and Coal-fish are taken less frequently, mostly by line fishermen. Of the other members of the genus *Gadus*, the Bib or Whiting Pout (*Gadus luscus*) is not uncommon, but is rather local in its distribution over the trawling area. The Poor Cod (*Gadus minutus*) is plentiful everywhere down to a depth of twenty-five fathoms, where its place is taken by the Norway Pout (*Gadus Esmarki*), which is present in large numbers all over the deeper areas of the Irish Sea, though it is only recently that its existence as an Irish fish has been recognized. There can be little doubt that the Poor Cod and Norway Pout form the basis of the food-supply of the carnivorous fishes of the district. The Bib, Poor Cod, and Norway Pout are known to the fishermen under the collective name of Pouting. The Three-bearded and Five-bearded Rocklings are common shore-fishes; but the Four-bearded Rockling (*Motella cimbria*) is an essentially deep-water species, and occurs in moderate numbers on the mud-area to the north-east of Rockabill, and probably over the whole Irish Sea, where the bottom is suitable. The Lesser Forkbeard, or Tadpole-fish (*Raniceps raninus*), and the Greater Forkbeard (*Phycis blennioides*) are said to have been taken a few times; but the occurrence of the latter must be regarded as quite exceptional, the nearest permanent

habitat of the species being on the south-west coast of Ireland, at a depth of about 100 fathoms. The Hake is a periodic visitor to the more off-shore grounds ; and the Ling is widely spread through the district, but not common.

From a commercial point of view the flat fishes are the most important group in the Dublin district. The Halibut is occasionally taken by long-liners. The Turbot and Brill, or, as it is locally called, Brit, are frequently trawled, the former usually on the coarse, sandy ground in the neighbourhood of the Kish Bank, and the latter all over the district, specimens being often taken in the shallow, sandy ground of Dublin Bay.

The Megrim or Ox Sole (*Rhombus megastoma*), which often figures in the fishmongers' shops under the name of White Sole, though far inferior to the fish to which that title really belongs, is abundant in the deep-water mud-district, but is rarely taken in less than twenty fathoms. Specimens of the Topknots (*Zeugopterus*) are rarely met with, as their usual haunt is on ground too rough for trawling, amongst rocks and stones, to which they can cling by converting themselves into a sucker. Müller's Topknot (*Z. punctatus*) is the only one which has as yet been recorded ; but it seems not unlikely that *Z. norvegicus* and *Z. unimaculatus*, both of which have been taken in the Irish Sea, also occur.

The Long Rough Dab (*Hippoglossoides limanoides*), better known locally as the Smeareen, is very abundant along the coast ; and much of the outcry against trawlers for the destruction of immature fish is based on the capture of this species, which is economically worthless, and does not reach a length of more than eight inches.

The Plaice, and its allies, the Lemon Sole (*Pleuronectes microcephalus*), the White Sole (*P. cynoglossus*), the Flounder (*P. flesus*), and the Dab (*P. limanda*), are all plentiful through the district, and are held in repute in the order named. The Plaice fishery, contrary to what is the case in the North Sea and the east side of the Irish Sea, is confined to a narrow strip along the coast which lies mainly inside the area in which steam-trawling is prohibited.

Though the Black Sole is often taken plentifully in a few

places off the Dublin coast, particularly to the south of Lambay, and on the southern parts of the Kish Bank, yet these areas are limited in extent, and the fish cannot be said to be common. The two unmarketable species of Solea, the Thickback (*Solea variegata*), and the Solenette (*S. lutea*) are also found—the former rarely, the latter abundantly. The Sand Sole (*S. lascaris*) does not occur.

The John Dory (*Zeus faber*) seldom reaches any considerable size; but small specimens of about six inches in length are frequently taken close to shore, especially in Dublin Bay.

The Herrings of Dublin Bay have long had a name for excellence, which was possibly gained by their greater freshness before the days of quick transit. The Herring fishing on the Dublin coast usually takes place from May to July, and is largely engaged in by English and Scotch as well as Irish boats. Sprats also occur throughout the district, but not in large numbers.

The Lesser Silver Smelt (*Argentina sphyraena*), a fish highly esteemed by connoisseurs, is to be found in moderate numbers in deep water. The common Smelt or Atherine (*Atherina presbyter*), which is in no wise related to the Silver Smelt, is also taken, but is not at all common.

Amongst the Elasmobranchs the commonest species is the Spur-dog (*Acanthias vulgaris*). The Smooth Hound (*Mustelus vulgaris*) and the Lesser-spotted Dog-fish, or "Sleepy Jimmy" (*Scyllium canicula*), are also fairly common; and the Blue Shark (*Carcharhinus glaucus*), probably a visitor from adjoining waters, is occasionally taken. The Tope (*Galeus canis*) and the Porbeagle (*Lamna cornubica*) are frequently captured, large specimens of the latter being sometimes exhibited as curiosities on the fishmongers' slabs. The Black-mouthed Dog-fish (*Pristiurus melanostoma*) is an inhabitant of the deep-water area, but is not common.

The Angel-fish (*Rhina squatina*) is much scarcer than on the west coast of Ireland. The Torpedo (*Torpedo nobiliana*) is occasionally taken off Dublin, and would probably be more frequently recorded if it were a little scarcer, and the fishermen not familiar with it.

The most abundant species of Ray is the Thornback, the





Photo. T. Mason.]

OPAH, OR KING-FISH (*Lampris luna*).

Captured at Lambay, 1906.

(From "Irish Naturalist," vol. xvi : $\frac{1}{2}$ natural size.)

Homelyn Ray (*Raia maculata*) and the Common Skate (*R. batis*) being also common. The Blonde Ray (*Raia blanda*), easily distinguished from the Homelyn, especially in small specimens, by its more yellow coloration and smaller and closer spots, extending to the margin of the disc, is very often met with ; and neither the Cuckoo nor the Shagreen rays is rare. Some other species of rays are said to have been taken in the district ; but it is doubtful to what the records refer.

In addition to the permanent inhabitants or regular visitors, mentioned above, there have been from time to time records of the capture of species whose occurrence must be regarded as quite exceptional. Amongst these we may mention the Red Mullet (*Mullus surmuletus*), which has been caught off Dalkey ; the Scabbard Fish (*Lepidopus caudatus*), taken in Dublin Bay ; and the Tunny (*Orcynus thynnus*), also from Dublin Bay. A Sucking-fish (*Echeneis remora*) was taken from a Blue Shark captured at Clontarf in 1848, and should, perhaps, be regarded as being as much a native as its host. The Opah (*Lampris luna*) (Plate XII) has twice been taken, at Skerries in 1851, and at Lambay in 1906 ; and a specimen of *Maurolicus borealis* was washed ashore at Killiney in 1847. There are occasional records of the Short Sunfish (*Orthagoriscus mola*), and every few years Sturgeon are reported from the Liffey. A specimen of the Spinous Shark (*Echinorhinus spinosus*) was taken at Skerries in 1882, and the Thrasher (*Alopias vulgaris*) is said to have been seen in Dublin Bay. Most of these records are of considerable antiquity, and it is not impossible that in some cases errors in identification may have occurred.

The fresh-water fishes of the Dublin district are few. The Liffey, in early ages, was highly thought of as a Salmon river, the Danish name of Leixlip, or Salmon Leap, being witness to the fact ; and, though its fame has somewhat diminished, we may hope that its recent cleansing may be followed by the return of its ancient reputation. The Sea Trout, or White Trout, as it is more usually called, is fairly common, especially in the southern parts of the county, and the Brown Trout is universal. The

Char (*S. alpinus*) occurs in Lough Dan in County Wicklow, but it is not often taken; it is also reported from Lough Tay. The Pike is not uncommon in suitable ponds and streams.

The Perch and Carp (the latter a doubtful native) are frequent both in natural and artificial waters, as is also the Rudd (*Leuciscus erythrophthalmus*), often known locally as the Roach. The Tench has been introduced in many places. In the streams may be found the Gudgeon, the Loach (*Nemachilus barbatus*), and the Minnow, the last-named being very abundant in the River Dodder. There is usually a tradition of the introduction of the Minnow in all the waters in which it is now found, but this does not preclude its being a true native. (Scharff, Irish Nat., 1905.) The Three-spined Stickleback may be found wherever there is enough water for it to swim, and the ten-spined species has occasionally been taken. The Fresh-water Eel is universally distributed, and large specimens may often be observed in the pond in St. Stephen's Green. The ascent of Elvers on the Dublin coast takes place in May and June, but not in large numbers.

The Sea-lamprey (*Petromyzon marinus*) frequents the Liffey, and the River-lamprey (*Petromyzon fluvialis*) has been taken in the Dodder. The Glutinous Hag (*Myxine glutinosa*), which often attacks the fish taken on fishermen's lines, has been found off Dalkey.

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TUNICATA.

By H. J. BUCHANAN-WOLLASTON.

The only record I can find of Tunicata found at Dublin is in a Report of the Dublin Bay Dredging Committee (Brit. Assoc. Report, 1860). The following are there represented in a "list of species obtained from Kingstown and Killiney Bays and a few from Baldoyle," viz.:—

Aplidium fallax.	Ascidia virginea.
Botryllus polycyclus.	Molgula tubulosa.
Ascidia mentula.	Cynthia aggregata.

Tunicata are alleged in the same report to be common on the North Scallop Bed, which consists of pure sand. The only Tunicate mentioned in Alder and Hancock's British Tunicata as having been taken in Dublin Bay is *Ascidia Morei* (Hancock), "North Wall, east, ashore."

Recently *Ascidia aspersa* has been dredged in numbers, while *Oikopleura* is often found in tow-nettings.

MOLLUSCA.**MARINE MOLLUSCA.**

By NATHANIEL COLGAN, M.R.I.A.

In attempting to exhibit here the characteristic features of the Dublin marine molluscan fauna, the seaward boundary of the county has been fixed at the conventional limit of what are known as territorial waters, or, roughly, at three miles' distance from low-water mark. The island of Lambay, two and a half miles from the nearest point of the mainland, belongs to the county, and the waters immediately surrounding the island are included in the Dublin marine limits. The marine area thus defined is pre-eminently a shallow-water area, as the term is understood in these days of abyssal dredging. In some points, as off Howth Head, off Dalkey, and off the Nose of Lambay, soundings of nineteen fathoms may be had; in many places and over considerable tracts the soundings range from ten to fifteen fathoms; but nowhere does the

depth attain to twenty fathoms, and by far the greater part of the area gives soundings ranging only from three to eight fathoms.

The diversified physical character of the Dublin shores and of the adjoining sea-bed is such as to produce a correspondingly varied molluscan fauna, in which all the principal families are well represented. After careful



FIG. 10.—Dalkey Sound.

revision of the extant records in the light of the experience gained by three years of desultory dredging and shore-collecting at various points along the coast from Killiney to Balbriggan, the present writer feels justified in fixing the total marine molluscan fauna of the Dublin littoral and shallow-water area as here defined at 292 species. Material for a comparison of the Dublin marine mollusca with those of the adjoining maritime county of Wicklow, or, indeed, with those of any other of the purely eastern maritime counties, does not exist; yet there can be little

doubt that the Dublin sea fauna is typical of the Irish coast from Carnsore Point northward to St. John's Point in Down, or, in other words, of District II of A. R. Nichols' "List of the Marine Mollusca of Ireland." In fact, so far as our present knowledge goes, the marine molluscan fauna of District II contains but four species not yet recorded for Dublin : *Chiton cancellatus*, *Rissoa fulgida*, *Idalia aspersea*, and *Lima subauriculata*.

The best-worked and, no doubt, the richest dredging-ground near Dublin is Dalkey Sound and its immediate vicinity within a mile radius of Coliemore Harbour. Here, in water ranging from five to eighteen fathoms, at least 175 species, or just 60 per cent. of the total marine Mollusca of Dublin, have been dredged from time to time. Amongst these the rarest for Dublin and, probably, for East Ireland are the following :—

<i>Chiton lœvis.</i>	<i>Philine catena.</i>
<i>C. ruber.</i>	<i>Dendronotus arborescens.</i>
<i>Cyclostrema nitens.</i>	<i>Antiopa cristata.</i>
<i>C. serpuloides.</i>	<i>A. hyalina.</i>
<i>Aclis unica.</i>	<i>Lomanotus marmoratus.</i>
<i>A. supranitida.</i>	<i>Doris aspera.</i>
<i>A. ascaris.</i>	<i>Nucula tenuis.</i>
<i>Lamellaria perspicua.</i>	<i>Leda minuta.</i>
<i>Rissoa striatula.</i>	<i>Mytilus phaseolinus.</i>
<i>R. violacea.</i>	<i>Crenella decussata.</i>
<i>R. vitrea.</i>	<i>Pecten striatus.</i>
<i>R. soluta.</i>	<i>P. similis.</i>
<i>Cæcum trachea.</i>	<i>Lima Loscombi.</i>
<i>C. glabrum.</i>	<i>Astarte sulcata.</i>
<i>Eulima bilineata.</i>	<i>A. triangularis.</i>
<i>E. subulata.</i>	<i>Lepton squamosum.</i>
<i>Odostomia pallida.</i>	<i>Tellina donacina.</i>
<i>O. rissoides.</i>	<i>T. pusilla.</i>
<i>Trophon truncatus.</i>	<i>Circe minima.</i>
<i>Utriculus hyalinus.</i>	<i>Mya Binghami.</i>
<i>U. mammillatus.</i>	<i>Solecurtus candidus.</i>
<i>Cylichna umbilicata.</i>	<i>Lyonsia norvegica.</i>
<i>Philine scabra.</i>	<i>Thracia prætenuis.</i>

As an instance of the richness of this ground in places, it may be mentioned that a single haul of shell-sand, made by the writer of these notes in October, 1906, about half a mile eastward of Dalkey Sound in thirteen fathoms and close by the rock known as the Muglins, yielded 95 species of Mollusca, many of them both rare and in large quantity. The haul included 25 specimens of *Trochus Montacuti*, 8 of *T. granulatus*, 37 of *Adeorbis subcarinatus*, 100 of *Cyclostrema serpuloides*, 40 of *C. nitens*, 20 of *Rissoa costata*, 95 of *R. semistriata*, upwards of 200 of *R. soluta*, 128 of *Cæcum glabrum*, 17 of *Odostomia spiralis*, and upwards of 100 of *Astarte triangularis*.

Of the two other deeper water dredging-grounds of the county, one lying immediately north of Howth Head, the other directly off the Nose of Lambay, the first has been utterly destroyed by an accumulation of rubbish drifted in from seaward, where the refuse of Dublin city for many years past has been discharged daily from hopper barges; the other, so far as can be judged from a few scrapings made in September last, is partly pure sand, barren of all save the commonest shells, and partly rocky bottom unworkable by the dredge.

Amongst the shore-collecting grounds of the county the Velvet Strand of Portmarnock has enjoyed a high reputation for fully a century. No less than 178 species have been recorded from this locality, amongst them *Tectura testudinalis*, *Capulus hungaricus*, *Rissoa violacea*, *R. vitrea*, and *Pholas crispata*. Another rich collecting-ground, though of far less repute than Portmarnock, and less thoroughly explored, is the strand of the North Bull, lying northward of Dublin Harbour. The writer's collections made here within the past three years give a total of 129 species, amongst which the Tectibranchs are well represented by the following 11 species:—*Actæon tornatilis*, *Utriculus obtusus*, *U. hyalinus*, *Scaphander lignarius*, *Cylinchna cylindracea*, *C. umbilicata*, *Philine aperta*, *P. scabra*, *P. punctata*, *P. catena*, and *P. pruinosa*. The rare species *Fusus Jeffreysianus*, *Scalaria Turtonæ*, *Defrancia gracilis*, and *Solen vagina* are cast up here from time to time; *Axinus flexuosus*, *Montacuta ferruginosa*, *M. bidentata*, and *Ceratisolen*

legumen are of quite common occurrence; and the beautiful valves of *Pholas candida* are frequently drifted in in a fresh state entangled in zoophytes. The shores of Lambay, which have been fairly well explored quite recently, produce 120 species, including *Trochus helicinus*, *Jeffreysia diaphana*, *Odostomia turrita*, *O. inaculpta*, *O. pallida*, *O. rissoides*, *Tellina donacina*, *Doris aspera*, and *Runcina Hancocki*; the South Bull, or Shelly Bank, south of the Liffey mouth, where the largest mass of drifted shells in the county occurs, yields amongst its rarer species *Trochus granulatus*, *Rissoa violacea*, *Pectunculus glycimeris*, and *Tellina squalida*; and round the shores of Shenick's Island, off Skerries, the northern *Tectura testudinalis*, which appears to find its southern limit for Ireland at Greystones, in Wicklow, is fairly common; the interesting nudibranch, *Polycera quadrilineata*, is frequent on Zostera beds laid bare at low-water of spring tides; and the cephalopod, *Sepiola atlantica*, may be caught with the hands in a few inches of water as one wades across to the island from the mainland.

One of the shallow-water dredging-grounds of the county is worthy of special mention, the Malahide River, a narrow channel connecting the extensive Malahide creek or lagoon with the sea, and giving soundings at low-water of from $1\frac{1}{2}$ to $2\frac{1}{2}$ fathoms. This is the *locus classicus* of three species of Nudibranchs, *Proctonotus mucroniferus*, *Aeolis alba*, and, *A. Farrani*, which were here first added to the Britannic marine fauna by Joshua Alder and Dr. Farran in 1844. Here, too, the Dublin Marine Biological Committee, in dredging-trips in August and November last, had the good fortune to add three rare mollusca, *Elysia viridis*, *Aeolis carulea*, and *Goniodoris castanea*, to the fauna of East Ireland.

The characteristic features of the marine molluscan fauna of Dublin are by no means obvious, yet they emerge with sufficient distinctness when that fauna is compared with the fauna of some definite Irish marine area remote from Dublin. The existence of Nichols' valuable "List of the Marine Mollusca of Ireland," already referred to, makes such comparison possible. A careful estimate based

on this work, supplemented by various papers since published, shows that the marine Mollusca of the Irish shores within the 20-fathom line numbers 440 species, while the molluscan fauna, within the same depth-limit of the Galway shores from Galway Harbour round to Ballinakill Harbour—an area as typically West Irish as Dublin is East Irish—amounts to 342 species.

With reference to their European distribution, a certain proportion of our marine Mollusca may be classed either as Boreal or Austral, the boreal species being such as range from within the Arctic Circle only so far south as the English Channel, the austral species such as range from the Mediterranean only so far northward as the Shetlands. Neither the European nor the Britannic distribution of one important section of our marine mollusca, the Nudibranchs, is sufficiently well known to permit of the species being classified in this way; and another and much smaller section, the pelagic Mollusca, a few of which are from time to time wafted to our western shores, have no title to a local habitation there, so that a more trustworthy estimate of the relative strength of the northern and southern elements in our marine faunas may be arrived at by excluding both Nudibranchs and pelagic species. So reduced, the totals for the marine Mollusca of Ireland, of Dublin, and of Galway will stand respectively at 363, 262, and 284 species; and of these totals the proportions belonging to the austral and boreal groups, as determined from the general distribution data given by Nichols in his List, are set out in the following table. It should be borne in mind that from insufficiency in the available data the classification here made is to a large extent tentative. The results arrived at must be taken as showing rather the nature than the precise amount of the differences between the faunas compared.

**AUSTRAL AND BOREAL SPECIES OF THE SHALLOW-WATER MARINE MOLLUSCAN FAUNAS OF IRELAND, OF DUBLIN, AND OF GALWAY,
WITH THEIR PERCENTAGE RATIOS TO THE TOTAL FAUNAS.**

	<i>Ireland.</i>	<i>Dublin.</i>	<i>Galway.</i>
Total fauna,	363	262	284
Boreal species,	15 or 4·1 p.c.	12 or 4·6 p.c.	8 or 2·8 p.c.
Austral species,	100 or 27·5 p.c.	48 or 18·3 p.c.	68 or 23·9 p.c.

The more northern facies of the marine Mollusca of the east coast of Ireland is shown in this table, not so much by the actual strength of the boreal element in the faunas of Dublin and Galway, as in the relations of the boreal to the austral element in each. Thus, while in Dublin the boreal element is one-fourth of the austral, in Galway it is less than one-eighth.

The purely arctic species, or species of arctic origin, as defined by Sars in his *Mollusca Regionis Arcticae Norvegiae* are somewhat better represented in Dublin, which has 47 species, or 18 per cent. of the total marine Mollusca of the county, than in Galway, which has but 43, or 15 per cent. of its total. Of the arctic species of Dublin not hitherto recorded for Galway, five—*Chiton ruber*, *C. marmoreus*, *Tectura testudinalis*, *Crenella decussata*, and *Pholas crispata*—would appear to be altogether absent from the west coast of Ireland; another arctic species, *Leda minuta*, not infrequently dredged living, in Dublin, has no stronger claim to a place in the west Irish fauna than can be drawn from a vague record of Turton dating from 1819; a sixth species, *Cyprina islandica*, common, and attaining to a large size in Dublin, appears to be quite rare along the west coast, and *Astarte sulcata*, a species of decided boreal tendency, at least in some of its forms, has so far been recorded for the west coast only as a deep-water species (165–280 fathoms), though quite frequent living in from 8 to 12 fathoms in Dublin.

In his Report of the Dublin Bay Dredging Committee¹ Kinahan drew attention to the absence from Dublin of southern types of Mollusca which occur farther north in Ireland. Such absences are still apparent. On comparison of the marine molluscan faunas of North Ireland, of South Ireland, and of East Ireland, Districts I, III, and II, respectively, of Nichols' List, we find that the following species, on record both for North and South Ireland, have not yet been observed in the intermediate District II. or East Ireland:—*Ovula patula*, *Philine nitida*, *Hermaea bifida*, *Nuculana pusilla*, *Arca lactea*, *Galeomma*

Turtoni, and *Pholadidea papyracea*. North Ireland has actually a much larger number, 68, of austral species as here defined than East Ireland, which has but 50, though the eastern district reaches fully two degrees of latitude farther south. There are in Eastern Ireland only 7 austral species not known to occur in North Ireland, and of these 5 are quite rare, and two of rather doubtful occurrence on the east coast. On the other hand, 25 of the North Ireland australs are as yet unrecorded for East Ireland. Of these 25 no less than 21 are found on the Irish west coast, 17 of these advance along that coast so far north as Galway, 8 advance still farther north to Killala Bay, and 5 reach even to Donegal Bay. The marine Mollusca of Donegal are as yet very imperfectly explored; and further investigation will probably show that a great majority of the austral species of North Ireland, including those which appear to be absent from our east coast, occur in Donegal, and are, in fact, continuously distributed along the west coast. It is on this coast that the austral group attains in Ireland its chief development. Of the 100 species forming the Irish group, 87 have been found on the west coast from Bantry Bay to Donegal Bay, against 50 on the east coast proper, from Carnsore Point to St. John's Point. If we assume these peculiarities in the Irish distribution of the austral group to be real, and not merely apparent and the result of unequal exploration of the areas compared, it would appear as if the austral species of North Ireland had arrived there by the western rather than by the eastern route, that they had travelled, in short, along what is certainly at present the line of least climatic resistance. But what, it may be asked, was the origin of our austral species? When did they first reach Ireland, and by what path did they travel? Are they relics of a pre-glacial migration along the old shore-line which existed when the land now forming the British Isles was part of a westward extension of the European continent? Or must we regard them as descendants of a later post-glacial invasion, which re-peopled our lifeless shores when they last freed themselves from the chill embrace of the glacier? No attempt can be made here to answer any of

these questions; but it may be asserted with some confidence that, however predominant may have been the influence of climate on the distribution of our marine organisms, it was by no means the sole agent at work. The form of the shores and of the sea-bed, the direction and force of currents, the secular oscillations of land-level which have given us our Ireland of to-day, even human agency itself—all of these influences have no doubt combined with climate in producing those so-called anomalies of distribution, which will never cease to exercise and to baffle the earnest student of marine zoology.

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LAND AND FRESHWATER MOLLUSCA.

By R. F. SCHARFF, PH.D., M.R.I.A.

On the occasion of the last visit of the British Association to Dublin, the Rev. B. W. Adams compiled a list of the Mollusca, as a whole, of the Counties of Dublin and Wicklow. The list published at that time was a very complete one, and comparatively few species have been added since. It is not necessary, therefore, to reprint it with additions; and I will only allude to some points in

which our existing knowledge has increased since 1878. The naturalists who particularly helped in improving our knowledge are Professor G. V. Hart, W. F. de V. Kane, G. P. Farran, J. R. Redding, Robert Welch, and P. H. Grierson, while I have contributed my own share to the work.¹

In comparing the old list with some of the more modern ones, the most striking difference is in the nomenclature. The great and unwieldy genus *Helix* had to be split up into separate sections; and the name *Zonites* is now applied to some forms living in the south of Europe only. Other minor changes have been made in almost every family.

Unfortunately there is as yet no agreement among naturalists as to the extent to which priority in nomenclature should be adopted, with the result that different names are applied by different authorities to well-known common species. Until some understanding has been reached, it is better to adhere to the name hitherto in common usage. As far as possible I shall attempt to follow B. B. Woodward's names, as given in his list of the British non-marine Mollusca.²

It is important to note that while the Irish molluscan fauna is characterized by the presence of certain peculiar molluscs like *Hyalinia hibernica*, *Vitrina pyrenaica*, *Pisidium hibernicum* and *Limnaea involuta*, some of which do not occur elsewhere, many genera, among them *Unio* and the families Viviparidae, Assiminiidae and Dreisensiidae, are completely absent from Ireland.

Testacellidae.—This family was not alluded to by Adams. *Testacella Maugei* and *T. halotidea* have occurred in gardens in the County Dublin.

Limacidae.—The Limaces and Arions, comprising most of our slugs, have generally been placed into one family, but they should certainly be separated. Only one *Limax* was recorded by Adams. We now know that *L. maximus*, *L. flavus*, and *L. arborum* are commonly distributed. Besides these, we find *Agriolimax agrestis*, *A. lævis*, *Amalia Sowerbyi*, and *A. gagates*.

¹ Irish Naturalist, vol. i., 1892. ² Journ. Conchol., vol. x., 1901-03.

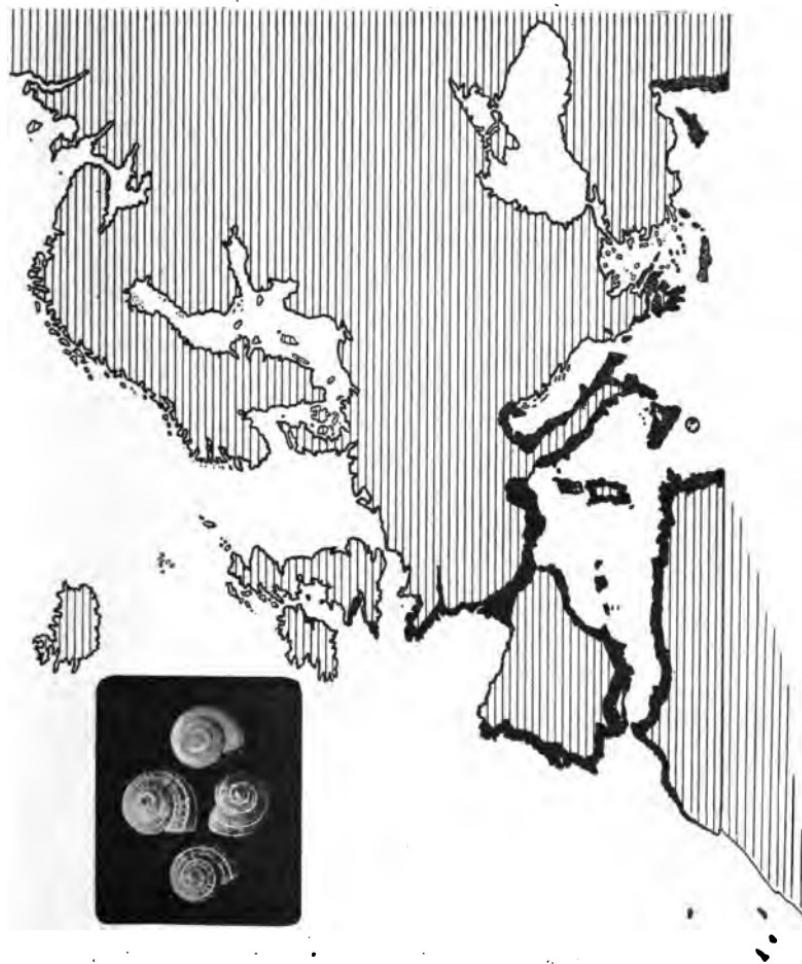


FIG. 11.—*Helix pista*, its geographical range shown by the black shading.

Arionidae.—*Arion ater*, *A. subfuscus*, *A. hortensis*, *A. intermedius*, and *A. Bourguignati* are all represented in the district.

Zonitidae.—The *Vitrina* recently discovered by Grierson in County Louth, and described by Taylor¹ as *V. elongata* and by Bowell² as *V. pyrenaica*, deserves special mention. It is a South European or Alpine species, and new to the Britannic area. Its range on the east coast may possibly extend southward into the County Dublin.

The species of the old genus *Zonites* are now placed among *Hyalinia* or *Vitrea*, *Zonitoides*, and *Euconulus*. The only addition to be made is that *Hyalinia lucida* (= *Draparnaudi*) certainly occurs in County Dublin.

Helicidae.—Perhaps one of the most interesting members of this family from a faunistic point of view is *Helix pisana*. This typical snail of the Mediteranean region (fig. 11) occur in Ireland only along the east coast, between the village of Rush in the County of Dublin, and the County of Louth.

Arianta abusorum, which was stated to be found near Dublin, does not occur there, though Farran met with it at Multyfarnham (Westmeath). *Helicella cantiana* and *Hygromia sericea* should also be expunged from the list of County Dublin Mollusca. Neither of them is found in Ireland.

Enidae.—This family contains the two species formerly placed under the genus *Buliminus* and now called *Ena*. Only one of them, *E. obscura*, inhabits Ireland.

Pupidae.—Among these it is worth noting that *Pupa anglica*, which in England has a peculiarly western range, is in Ireland abundant both east and west, particularly in woods.

[*Cyclostomatidae*.—In the last Dublin list, *Cyclostoma elegans* is stated to have been found in the Glasnevin Botanic Gardens. It may have been temporarily introduced, but neither there nor elsewhere in Ireland have living specimens been found since.]

Limnaeidae.—Among this family the large *Planorbis corneus* deserves special mention, because it inhabits only a

¹ Irish Naturalist, vol. xvi., 1907, pp. 225–230.

² Ib., xvii., 1908, pp. 94–8.

comparatively small tract in the centre of Ireland. Its range extends from there as far east as Maynooth in the County Kildare.

Paludestrinidae.—Quite a new and interesting discovery, which has recently been made by R. Welch, of Belfast is that *Bithynia Leachii* inhabits an area of Ireland rather similar to that occupied by *Planorbis corneus*.

ARTHROPODA.

INSECTA.

BY GEORGE H. CARPENTER, B.S.C.; J. N. HALBERT, M.R.I.A.; and
W. F. DE V. KANE, M.A.

HYMENOPTERA.

Owing to the neglect of the Tenthredinidæ (Sawflies) by local collectors there are few available records of the family, and no list of the species occurring in the district has ever been published. First in importance, from its economic interest, is the Great Pine Sawfly (*Sirex gigas*), an insect which would appear to be greatly on the increase in Ireland. Every summer numbers of so-called "Hornets" are received by naturalists for identification from various parts of the country, and they invariably prove to be this fine sawfly. It has been found in several places in the district, and has been noticed¹ as very abundant in Silver Fir trees at Kippure, Co. Wicklow, a single stump containing hundreds of its larvæ and pupæ. Of much greater rarity is the Blue Sirex (*S. juvencus*). In the Dublin Museum there is a specimen of this beautiful insect, which was captured alive in a house in Hume Street some years ago. Other species of economic interest are the Pine Sawfly (*Lophyrus pini*) at Powerscourt; the Pear Sawfly (*Eriocampoides limacina*) which damaged the foliage of pear-trees at Glasnevin in October, 1898; *Athalia rosa*, *Selandria serva*, and the Gooseberry Sawfly (*Nematus ribesii*), an exceedingly destructive insect in Dublin gardens. The recent discovery of the larvæ of the rare *Nematus maculiger*, Cameron, feeding on Japanese Larch in

¹ J. H. LEACH.—“*Sirex gigas* in Ireland.” Entom., 1891, p. 248.

the grounds of St. Anne's, Clontarf, is also of interest. The following species also occur :—*Cimbex femorata*, L. (has occurred at Foxrock); *Trichiosoma lucorum*, L. (Bray); *Tenthredopsis cordata*, Fourc. (Howth, &c.); *Hylobius fuscipes*, Fall.; *Emphytus calcatus*, Klug. (Tibradden); *Strongylogaster delicatulus*, Fall.; *Cladius pectinicornis*, Fourc. (Portmarnock); and *Fenella nigrita*, Westwood (a rare species noted in A. H. Haliday's manuscript list as occurring at Portmarnock).

Since the publication of A. H. Haliday's classical researches on the parasitic Hymenoptera, very little attention has been given to this extensive and important group of insects in Ireland. In a paper¹ which appeared seventy years ago he described several new species of Ichneumons. Amongst these we find *Acrodactyla serricornis*, Hal., recorded from Wicklow; *Helictes varius*, Hal., from Portmarnock; and *Mesochorus arenarius*, Hal., a species parasitic on spiders, from the same locality. Certain other species mentioned in this paper may be presumed to occur, such as *Acrodactyla madida*, Hal., and *A. degener*, Hal., which are quaintly referred to as occurring in "Ireland, in shady groves."

A large and handsome ichneumon, *Rhyssa persuasorius*, has been found at Avondale, and in the Devil's Glen, County Wicklow, where it probably attacks the larvæ of the Great Pine Sawfly (*Sirex gigas*).

No local list of ichneumons has been published, but many species are preserved in the Dublin Museum collection. Amongst those are the following :—*Chasmodes lugens*, Grav.; *Ichneumon deliratorius*, L.; *Euxophanes occupator*, Wesm.; *Amblyteles oratorius*, Fab.; *Phaogenus planifrons*, Wesm.; *Campoplex bucculentus*, Holmgr.; *Mesoleius fallax*, Holmgr.; *Bassus tarsatorius*, Panz.; *Perithous mediator*, Grav.; *Pimpla examinator*, Fab.; *P. maculator*, Fab.; *Phytodictetus segmentator*, Grav.; and *Triolister podagricus*, Grav.

The smaller parasitic Hymenoptera of the families Cynipidæ, Proctotrupidæ, &c., were monographed by Haliday

¹ A. H. HALIDAY.—"New British Insects indicated in Mr. Curtis's Guide." Ann. Mag. Nat. Hist., ii., 1838-39, pp. 112-121.

many years ago in an important series of papers¹ that are still indispensable to students of these minute insects.

Among hymenopterous insects the only groups which have been carefully studied by local entomologists are the Aculeata, namely, the ants, bees, and wasps. In 1896 was published a list of the Irish species, compiled by Percy E. Freke,² largely the result of his own researches, combined with those of his coadjutor, H. Gore Cuthbert. Up to the present time about 150 species of these interesting insects have been recorded from Ireland, and close on a hundred of these are known to occur in the counties of Dublin and Wicklow.

In suitable localities throughout the district four species of ants are more or less abundant; these are *Formica fusca*, *Lasius flavus*, *L. niger*, and *Myrmica rubra*; the last is represented by at least three distinct races. The large Wood Ant, *Formica rufa*, is our rarest species. It has not been recently recorded by collectors from our district, but Haliday notes in his manuscript list of Irish insects that it was found many years ago by Mr. Alfred Furlong near Clara in County Wicklow. It will be remembered that the Wood Ant is very local in Ireland, being most frequently met with in County Kerry.

With the exception of the common Hornet (*Vespa crabro*), an insect which has fortunately never been found in this country, all the British species of social wasps (*Vespa*) occur in varying abundance. According to statistics kept by Mr. R. M. Barrington of the number of queen wasps killed in early summer at Fassaroe, near Bray, it would appear that on an average *Vespa vulgaris* is by far the commonest Wasp in that locality; *V. sylvestris* comes next in numerical importance; while *V. rufa*, *V. germanica*, and *V. norvegica* occur in about equal numbers.

Of special interest to naturalists is the rare wasp *Vespa*

¹ A. H. HALIDAY.—“An Essay on the Classification of the Parasitic Hymenoptera of Britain, which correspond with the *Ichneumones minuti* of Linnaeus.” Entomologists’ Magazine, vols. i.-v., 1833-1838.

² FREKE, PERCY C.—“A List of Irish Hymenoptera Aculeata.” Irish Naturalist, vol. v., 1896, pp. 39-43.

austriaca (fig. 12) now known to occur in several places in our district. Although both the male and queen of this mysterious wasp have been known for many years, no "workers" clearly referable to the species have ever

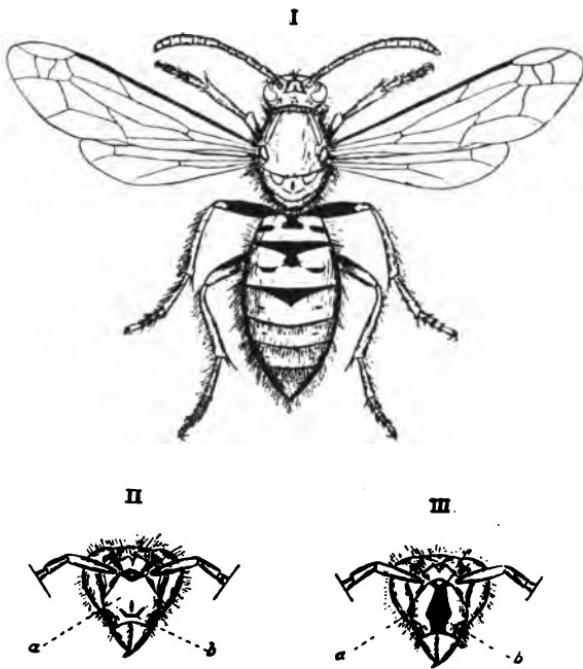


FIG. 12.—i. *Vespa austriaca*, Queen; ii. face of *V. austriaca* ;
iii. face of *V. rufa*. Magnified.

After Cuthbert, Ir. Naturalist, vol. vi.

been found. For this reason, the opinion has been very generally held that this wasp is parasitic on some other species of *Vespa* in much the same way that the bees of

the genus *Psithyrus* are parasitic on the true Humble Bees (*Bombus*). The belief that the host is *Vespa rufa* seemed placed beyond doubt when Robson recorded his discovery of both male and female *austriaca* in a nest of that species. The recent finding in County Carlow of a nest containing both *V. rufa* and *V. austriaca*, induced Carpenter¹ and Pack-Beresford carefully to reinvestigate the relationship between these two wasps. A comparison of the colour-markings and general structure, especially of the sexual characters, showed that although they are constant forms that do not merge, yet the resemblances are so close that they may be considered as races of one and the same species, a fact which would in itself render the supposed relationship of host and inquiline somewhat doubtful. This similarity of structure, combined with other interesting points, such as a certain tendency of the two wasps to vary, the one towards the other, the construction and position of the nest, and especially the discovery in the nest of an old *austriaca* queen, led to the belief that the latter was the true foundress of the colony, and that both the *rufa* and *austriaca* forms were her offspring. "As regards the precise relationship between *V. austriaca* and *V. rufa*, we believe that the former represents the ancestral stock of the latter, because *V. rufa* shows distinctly more tendency to vary, while the rarity and discontinuous distribution of *V. austriaca* suggest that it is the older form. Moreover, as all the workers of these wasps are clearly referable to *V. rufa*, it seems that *V. austriaca* points us back to a time in the history of the race before the worker had become differentiated from the queen." It is hoped that, some direct evidence of the actual nest-building by a queen of *Vespa austriaca* will eventually be forthcoming in support of these views.

The bees of the parasitic genus *Psithyrus* are not numerous in local collections, but at least three kinds have been found, namely, *Psithyrus vestalis*, *P. barbutellus*,

¹ G. H. CARPENTER, and DENIS R. PACK-BERESFORD. "The Relationship of *Vespa austriaca* to *Vespa rufa*." Irish Naturalist, xii., pp. 221-238.

and *P. campestris*, while at least seven species of Humble Bees are more or less common, *Bombus latrællellus*, var., *distinguendus*, found at Arklow, and *B. jonellus* are perhaps our most local species.

Several notable insects which find a place in English lists do not apparently occur in Ireland. We may refer as example to the entire family Mutillidæ, and to the genus Cerceris.

The following are a few of the more local species of "Fossores" found in the district:—*Astatus boops*, Schr. (Donabate), *Pemphredon Wesmæli*, Moraw (Monkstown), *Crabro palmipes*, L. (Portmarnock, &c.), *Odynerus spinipes*, L. (Killiney), *Prosopis confusa*, Nul. (Glencullen), *Sphecodes similis*, Wesm. (Glencullen), *Halictus leucopus*, Kirb. (Dundrum), *Andrena helveola*, Kirb. (Blanchardstown), *A. fucata*, Smith (Portmarnock), *Nomada borealis*, Zett. (Stillorgan Park), *N. ferruginea*, Kirb. (Glencullen).

J. N. H.

DIPTERA.

Our knowledge of the two-winged flies of the Dublin district, and indeed of Ireland generally, is due for the most part to the researches of the late A. H. Haliday, whose collections are preserved in the Dublin Museum. His catalogue of County Down Diptera,¹ published more than seventy years ago, contains descriptions and records of insects taken in Counties Dublin and Wicklow. The noteworthy species mentioned in this article have been compiled from his papers, from his unpublished records and collections, and from certain small collections made in recent years by various naturalists, and preserved in the Dublin Museum.

Beginning with the Nematocerous division of the Orthorrhapha, it may be said that of the Cecidomyidæ of the district practically nothing is known, except the occasional presence of *Diplosis pyrivora*, Riley, in pears. A few

¹ A. H. HALIDAY. "Catalogue of Diptera occurring about Holywood in Downshire." *Entom. Mag.*, vol. i., 1833. Also Notes, &c., upon Diptera. *Ibid.*, vol. iv., 1837.

Mycetophilidæ are on record, including *Zygoneura sciarina*, Meig., from Ashford, County Wicklow. Of the Bibionidæ, *Bibio pomona*, Fb., *B. johannis*, Linn. and *B. claripes*, Mg., all occur in the Dublin and Wicklow hills. Noteworthy Chironomidæ are *Tanypterus pusillus*, Mg. (County Wicklow), *Diamesa tonsa*, Halid. (Templeogue, County Dublin) and above all *Clunio marinus*, Halid., which may be found on the shores of Killiney Bay, near Dublin, at low spring-tides, skimming over the surface of the rock-pools.¹ This is one of the most interesting of our marine insects, the larvæ living entirely submerged, and feeding on green seaweed, while the perfect midges—the males with delicate white gauzy wings and the curious elongate, wingless females—are to be seen only at low spring-tides. *Orphnephila testacea*, Ruth., occurs in County Wicklow, and the local Psychodidæ include *Pericoma ocellaris*, Mg., *Psychoda bullata*, Hal., and *Trichomyia urbica*, Hal. Among the Dublin Culicidæ *Anopheles nigripes*, Mg., is worthy of mention. The Limnobiidæ of the district include *Geranomyia unicolor*, Halid. (Malahide), *Rhamphidia longirostris*, Meig. (Murrough of Wicklow), *Epiphragma picta*, Fb. (County Wicklow), and *Amalopis littoralis*, Mg. (Glenasmole, County Dublin). Besides many common Tipulidæ, we have *Dolichopeza sylvicola* Curt. (County Wicklow), *Pachyrhina histrio*, Fb. (Dundrum), *Tipula gigantea*, Schr. (County Wicklow), *T. varipennis*, Mg. (Maynooth), and *Xiphura atrata*, Linn. (Powerscourt).

Turning to the Brachyrerous division of the Orthorrhapha, the Stratiomyidæ are fairly represented in the district, among the species on record being *Stratiomys furcata*, Fb. (Kilcool, County Wicklow), *Sargus flavipes*, Mg. (Lucan), and *Beris claripes*, Linn. (Howth). Among the Tabanidæ, we have, besides the common species of *Hæmatopota* and *Chrysops*, *Tabanus sudeticus*, Zell, in County Wicklow. Noteworthy Leptidæ of the district are *Chrysopilus auratus*, Fb. (Portmarnock), *Atherix ibis*, Fb.

¹ A. H. HALIDAY. "Description of Insects figured, &c." Nat. Hist. Rev., vol. ii., 1858. G. H. CARPENTER. "The Insects of the Sea." Knowledge, vol. xxiv., 1901 (pp. 197-8).

(County Wicklow), and *Spania nigra*, Mg. (County Wicklow). The Asilidæ are poorly represented, only *Philonicus albiceps* Mg., *Epitriptus cingulatus*, Fb. (Portmarnock), and *Neotamus cyanurus*, Lw., Wicklow, being known in the neighbourhood. Of the Bombyliidæ, we have, in Counties Dublin and Wicklow, *Bombylius minor*, L., *B. canescens*, Mik., and *Phthiria pulicaria*, Mik. There are numerous Empidæ, including *Rhamphomyia hybotina*, Zett. (Arklow), *Empis borealis*, Linn., which may be taken on the moors around Lough Bray, County Wicklow in springtime, *E. bilineata*, Lw. (banks of the Royal Canal), *Hilara matrona*, Halid., *Clinocera bipunctata*, Halid., *C. bistigma*, Curtis (County Wicklow), *Stilpon lunata*, Wlk. (County Dublin), *Tachydromia pectoralis*, Fall., and *T. cursitans*, Fb. (County Wicklow). The Dolichopodidæ have been but little studied. Among their recorded species may be mentioned *Dolichopus atratus*, Mg. (County Wicklow), *Tachytrechus consobrinus*, Wlk. (Co. Wicklow), *Diaphorus oculatus*, Fall., *D. Winthemii*, Mg., and *Porphyrops crassipes*, Mg. (Co. Wicklow), *Machaerium maritimum*, Halid. (Co. Wicklow), *Hydrophorus balticus*, Mg. (River Dodder, County Dublin), *Liancalus virens*, Scp. (Co. Wicklow), *Campsicnemus scambus*, Fall., *C. curvipes*, Fall., *C. armatus*, Zett., and *C. pusillus*, Mg. (County Dublin), *Ectomus alpinus*, Halid., and *Schoenophilus versutus*, Wlk. (County Wicklow).

The higher sub-order of the Cyclorrhapha must now be briefly reviewed. The commoner species of Syrphidæ are numerous in individuals; among the members of this family may be mentioned *Sphegina clunipes*, Fall., *Merodon equestris*, Fb., and *Chrysotoxum arcuatum*, Linn., which have been found near Dublin, and *Sericomyia lappona*, Linn., which occurs in Kildare. The Oestridæ are represented by *Gastrophilus equi*, Fb., and *Hypoderma bovis*, Linn., the latter being apparently far more frequent in Ireland than *H. lineata*, Vill., which in England is now regarded as the "Common" Warble-fly. There are no records of Tachinidæ, nor of Muscidæ and Anthomyidæ, except common and generally distributed species. The shore-haunting flies of the Phycodromidæ are well represented on the Dublin and Wicklow coasts, *Fucellia fucorum*, Fall.,

Orygma luctuosum, Mg., *Celopa pilipes*, Hal., and two or three species of *Fucomyia* being present. Another sea-coast fly, *Actora aestuum*, Mg., belonging to the Sciomyzidæ, occurs at Portmarnock; and in the same locality Haliday discovered the handsome south European species *Lucina fasciata*, Mg.; in the same family we have also *Neuroctena anilis*, Fall. *Loxocera sylvatica*, Fall. (County Wicklow), and *Psila atra*, Mg. (County Dublin), are notable Psilidæ. Among the Ortalidæ, Tryptidæ, and Sapromyzidæ may be mentioned *Rivellia syngenesia*, Fb., *Trypetia florescentia*, L., and *Lauxania cylindricornis*, Fb., which have been found in County Wicklow. The tiny *Geomyza sabulosa*, Halid., with its reduced wings, is one of the most interesting of Haliday's discoveries on the Portmarnock sandhills. *Tethina illota*, Halid., also a County Dublin insect, belongs to the same family (Geomyzidæ). There are some interesting records among the Ephydridæ, notably *Glenanthe ripicola*, Halid., *Attisa pygmæa*, Halid., and *Canace nasica*, Halid., from the Baldoyle salt-marsh; also *Hecamede albicans* Mg., and *Phylhygria punctonervosa*, Fall. (Portmarnock), *Pelina aenescens*, Stph. (County Wicklow), and *Tichomyza fusca*, Macq. (County Dublin). Of the Chloropidæ, besides common and well-known farm-pests, like *Chlorops tæniopus*, Meg., and *Oscinis frit*, Linn., *Elachyptera cornuta*, Fall., has been lately noticed damaging barley near Dublin. *Oscinis rapta*, Halid., was taken by its describer in Phoenix Park. *Phyllomyza securicornis*, Fall., has occurred in County Wicklow. Among Agromyzidæ from the district are *Agromyza flavonotata*, Halid., *Ochthiphila geniculata*, Halid., and *O. flavidalis*, Halid. (County Wicklow). There are no reliable records of Borboridæ from the district. Among the Hippoboscidæ we have, besides the inevitable *Melophagus ovinus*, Linn., all three of the usual bird-parasites:—*Ornithomyia avicularia*, L., *Stenopteryx hirundinis*, L., and *Oxypterum pallidum*, Leach.

G. H. C.

LEPIDOPTERA.

The following notice is confined to the lepidopterous fauna of an area of country within easy reach of an ordinary day's excursion from the City of Dublin, scarcely extending beyond the boundaries of the two adjacent counties of Dublin and Wicklow. Within this circuit, however, may be found a variety of habitats suited to special groups of insects. The foreshore and sandhills of the coast stretching from Drogheda to Arklow, including the cliffs of Lambay, Howth, Bray Head, and Wicklow Head are peculiarly prolific of maritime species. The ranges of the Dublin and Wicklow Mountains, with their attendant heathery tracts and extensive bogs, are well supplied with those of the moorland, while the woodlands and glens of Wicklow, anciently clothed with primeval forests of wide extent, harbour a forest fauna; and lastly, the cultivated districts with hedgerow and wayside plants supply a good sample of widely-distributed species common to the greater portion of rural Ireland. These latter, however, as well as the denizens of the woodland, cannot compare in numbers or variety with those of similar areas in England. This may be partly accounted for by the result of geological agencies which in early ages restricted the fauna of islands in proportion to their relative proximity to, and date of disconnection from, the nearest continent. But the more westerly position of Ireland has also been a potent factor in checking later introductions since its insulation. For southerly and south-westerly winds frequently bring an accession of flying insects across the Channel from France to England, of which few except those of very powerful flight wander so far west as the shores of the south of Ireland. Migrants from England or Scotland may very confidently be asserted never to make their way by flight across the Irish Channel, for easterly and south-easterly winds are prohibitive of migration, since they paralyze the activity of Lepidoptera. Moths of powerful flight, however, such as the Sphinges, must be excepted, for the direction of the wind is immaterial as regards the objective of their wanderings. The groups of lowland and woodland

species are probably the most deficient as compared with those of England, for at the close of the last Glacial epoch, while Ireland was still an integral portion of the Continent, such insects as fed on anemophilous plants and subalpine vegetation would arrive first, following the retreating ice-foot, then the maritime groups, taking advantage of the more equable temperature and sheltered spots of the sea-coast. Next to these came such as feed on hardy scrub such as birch, oak, sallow, and alder, probably followed by such of the lowland fauna as are more or less polyphagous. Then, as the climate improved and a varied collection of more tender plants and trees established themselves, they would be accompanied by the insects appropriate to them, and by such as are restricted to special food-plants. It was during the progress of this later influx that further accessions from England were arrested by the re-entry of the sea into the Irish Channel. The district now under review, however, as regards its maritime fauna, may challenge comparison with most stretches of British coast, if we except the sunny littoral of the English Channel; and the peninsula of Howth is especially pre-eminent for its numerous and interesting species. Its contiguity to the metropolis has of course ensured a more exhaustive exploration than less proximate localities; but it would also seem that the present promontory represents the remnant of a much more extended area, whose surface harboured a varied fauna and flora now concentrated into the present narrow bounds. The survival of *Calamia (Nonagria) lutescens* in a patch of reeds a few yards in extent on the slope of the cliff seems to support this hypothesis. On the south cliffs, near the Bailey Lighthouse, a colony of *Lithosia caniola* formerly flourished, and here also *Dianthæcia luteago* var. *Barrettii* (fig. 18) is to be taken in company with its congeners *D. capsophila*, *nana*, *cucubali*, and *capsincola*. This remarkable brown variety of the buff-coloured Continental type, named after its first captor, the late Charles G. Barrett, is a very stable form. One bred example only has been noted to have shown a slight trace of yellow in the markings when freshly emerged, which, however, faded afterwards. The Continental type frequents locali-

ties in certain mountain districts, as do also *Dianthæcia casia* and *D. capsophila* abroad. It is therefore interesting to note that the Irish and Manx coast form of *casia* also shows an analogous melanic deviation. Here, as in other instances, such as *Nyssia zonaria*, *Mesotype virgata* (*Eubolia lineolata*), &c., we find evidence among the Lepidoptera of a parallelism of suitability between maritime



FIG. 13.—*Dianthæcia luteago*: var. *Barrettii* (below) and Continental type (above). From Carpenter, in "Ireland, Industrial and Agricultural."

and subalpine habitats, to which the Dianthæcian food-plant *Silene maritima* and the common Sea-thrift bear witness also among flowers. *Dianthæcia Barrettii* has also been taken at Tramore and the coast of Cork, and a few have occurred on the Welsh, North Devon, and Cornish coasts. None of these littoral forms shows any approach to the tint of typical *D. luteago*, though they exhibit some

local diversity in the tone of ground-colour. Research among the microlepidoptera has unfortunately been extremely neglected in Ireland, so that Mr. Barrett's catalogue, compiled in 1866, has not been very largely extended by recent additions. Mention must be made, however, of *Mixodia palustrana*, *Tinea confusella*, and *Argyritis tarquinella* as occurring in the district. The last has as yet only been taken at Howth, the second perhaps also in Lancashire. *Flachista flaviomella* was for many years only known from Howth captures, till a few were taken near Glasgow. The following localities may be cited as probably the most productive in the county of Dublin. For shore-insects Howth, and the coast from Balbriggan to Skerries. For inland species the country lying along the spurs of the Two-Rock Mountain from Carrickmines and Kilternan to the Scalp. In Wicklow the woods and moors of Powerscourt to Roundwood, Rathnew to the Devil's Glen, Woodenbridge neighbourhood, and Tinahely to Shillelagh. The fens from Kilcoole to Newcastle, the "Murrough" of Wicklow, and the shore from Greystones to Bray Head have produced very interesting species. A note of some of the rarer Lepidoptera of the district is here appended. *Plusia illustris* should be noted, one specimen of which was taken in 1887. The nomenclature of South's list is followed as most generally known. Species occurring in both Dublin and Wicklow counties have no indication of locality appended. If confined to either one or the other, the initial D. or W. indicates the distribution.

RHOPALOCERA.

- | | |
|-------------------------------|------------------------|
| <i>Melitaea aurinia Rott.</i> | L. <i>argiolus L.</i> |
| <i>Lycæna ægon Schiff. W.</i> | L. <i>minima Fues.</i> |

HETEROCERA.

- | | |
|------------------------------------|----------------------------------|
| <i>Acherontia atropos L.</i> | Macroglossa <i>bombyliformis</i> |
| <i>Deilephila galii Schiff.</i> D. | <i>Esp.</i> (narrow-bordered). |
| <i>D. livornica Esp.</i> D. | <i>Trochilium crabroniformis</i> |
| <i>Chærocampa porcellus L.</i> | <i>Lewin.</i> D. |

HETEROERA—continued.

- Trochilium apiformis Clerck.* A. *agathina Dup.* D.
D. *Noctua Dahlii Hb.* D.
Sesia myopiformis Bork. D. *Panolis piniperda Panz.*
Gnophria quadra L. W. *Tæniocampa populeti Fb.* W.
Spilosoma mendica, v. rustica
Hb. D. *T. miniosa Fb.*
T. munda Esp.
Cossus ligniperda Fb. W. *Dasycampa rubiginea Fb.* W.
Notodontæ dictæoides Esp. *Calymnia affinis L.*
N. trepida Esp. W. *Dianthæcia luteago, v. Bar-*
Acronycta megacephala Fb. *rettii Dbld.* D.
A. alni L. W. *D. capsophila Dup.*
Leucania littoralis Curt. *Dasypolia templi Thnb.* D.
Calamia lutosa Hb. D. *Epunda lichenea Hb.* D.
Xylophasia hepatica L. *Hadena glauca Hb.* D.
Neuria reticulata Vill. D. *H. dissimilis Kn.* W.
Luperina cespitis Fb. *H. Contigua Vill.* W.
Mamestra abjecta Hb. D. *Xylina socia Rott.*
M. sordida Bork. *Asteroscopus sphinx Hufn.*
M. furva Hb. D.
Apamea unanimis Tr. D. *Cucullia chamomillæ Schiff.*
A. ophiogramma Esp. D. *Plusia illustris Fb.* Castle
Miana bicoloria v. rufuncula, Kevin, W. One.
D. *P. bractea Fb.*
Celaena Haworthii Curt. *Heliothis peltigera Schiff.* W.
Stilbia anomala Haw. *H. armigera Hb.* D.
Agrotis lunigera St. D. *Chariclea umbra Hufn.*
A. obelisca Hb. D.

GEOMETRÆ.

- Selenia lunaria Schiff.* W. *E. constrictata Gn.* W.
Amphidasys strataria Hufn. *E. expallidata Gn.*
W. *E. dodoneata Gn.* W.
Aspilates gilvaria Fb. W. *E. debiliata Hb.* W.
Larentia salicata Hb. W. *Lobophora sexalisata Hb.*
L. olivata Bork. W. *W.*
Emmelesia unifasciata Haw. *Camptogramma fluviata Hb.*
D. *D.*
Eupithecia pygmæata Hb.

PYRALIDES.

Scoparia cembræ Haw. D. *S. angustea St.*
S. lineolata Curt. D.

CRAMBITES.

Plodia interpunctella Hb. D.

TORTRICES.

<i>Dichelia grotiana Fb.</i>	W.	<i>Phoxoptyryx unguicella L.</i>
<i>Amphysa gerningana Schiff.</i>	W.	<i>Grapholitha geminana St.</i>
<i>Peronea permutana Dup.</i>	W.	<i>Phlaeodes immundana Fisch.</i>
<i>Spilonota incarnatana Hb.</i>	W.	<i>Coccyx vacciniana Fisch.</i> D.
<i>Howth.</i>		<i>Pamplusia mercuriana Hb.</i>
<i>Sciaphila colquhounana Sta.</i>	D.	<i>Eupœcilia pallidana Zell.</i>
<i>Howth.</i>		<i>Howth.</i>
<i>P. myrtillana Tr.</i>	W.	

TINEIDES.

<i>Diplodoma marginepunctella St.</i>	W.	<i>Gracillaria phasianipennella Hb.</i>
		<i>Howth.</i>
<i>Tinea confusella H-S.</i>		<i>Coleophora vitisella Greg.</i>
<i>Howth.</i>		<i>W.</i>
<i>Eriocephala aureatella Scop.</i>		<i>C. olivacea Sta.</i>
<i>L. Bray,</i>	W.	<i>Howth.</i>
<i>Depressaria rhodochrella,</i>		<i>Asynchna modestella Dup.</i>
<i>H-S.</i>	Howth.	<i>D.</i>
<i>Lita leucomelanella Zell.</i>		<i>Elachista flavicomella Sta.</i>
<i>Howth.</i>		<i>Howth.</i>
<i>Teleia humeralis Zell.</i>	W.	<i>E. dispunctella Dup.</i>
<i>Argyritis tarquiiniella Sta.</i>		<i>Howth.</i>
<i>Howth sandhills.</i>		<i>Lithocolletis irradiella Scott.</i>
<i>Glyphipteryx Haworthiana St.</i>	W.	<i>D.</i>
		<i>L. bremiella Zell.</i>
		<i>W.</i>
		<i>Bucculatrix maritima Sta.</i>
		<i>Howth.</i>
		<i>Nepticula acetosæ Sta.</i>

W. F. DE V. K.

COLEOPTERA.

The first general list of the Beetles occurring in the Dublin district was compiled by A. R. Hogan¹ more than fifty years ago. It was based on the unpublished



FIG. 14.—Old Beech stump eaten by Holly Weevil
(*Rhopalomesites Tardyi*).

researches of a number of entomologists, who were pioneers in the study of Irish insects during the early

¹ "Catalogue of Coleoptera found in the neighbourhood of Dublin." *Zoologist*, xi., 1853, p. 4134; xii., 1854, pp. 4195-4338.

part of the last century, notably of Alexander H. Haliday, Alfred Furlong, and James Tardy. This list, containing some 600 species, was revised by the late Professor W. R. M'Nab for the British Association Guide of 1878. In recent years the records have been largely increased, and all were incorporated in a list of Irish Coleoptera, published about five years ago.¹

The Beetle fauna of the district is fairly well known, although a considerable amount of work remains to be done, especially in parts of Wicklow. In County Dublin, with its larger area of cultivated land, the more interesting species occur in a remarkably local manner, and for this reason certain localities have ever been the favourite hunting resorts of Dublin coleopterists. Such are the sand-hills and salt-marshes of the north Dublin coast, the Dodder valley, and the glens of the Dublin hills. In County Wicklow there are several highland lakes, and a large area of moor and mountain, which have not been thoroughly explored.

It is well known that there are in our district a few interesting forms which are characteristic of south-western Europe. Perhaps the most notable of these is the Holly Weevil *Rhopalomesites Tardyi* (fig. 14), which lives in the old holly trees of Powerscourt deerpark, where the original specimens from which the species was described were discovered many years ago. It is often injurious to the wood of various trees. Another interesting weevil (*Otiorrhynchus europunctatus*) (fig. 15), found abroad at high altitudes in the mountains of France and Spain, occurs with us at sea-level in various places between Wicklow and Louth. On our coasts there are also found several uncommon beetles, which may be referred to the same faunistic group. Such are *Nebria complanata*, a handsome species, reaching its most northerly Irish station in the Arklow district; *Octhebius Lejolisi*, *Phytosus nigritiventris*, and *Bryaxis Waterhousei*.

In woodland beetles the list is rather a poor one; the recent discovery near Rathdrum of so conspicuous an insect as *Strangalia aurulenta*, a "longhorn" previously

¹ W. F. JOHNSON and J. N. HALBERT: "A List of the Beetles of Ireland." Proc. R. I. A., ser. iii., vol. vi., pp. 535-827.

supposed to be of exclusively south-western range in this country, gives promise of other interesting species in County Wicklow.

Among the rarer mountain forms are the ground beetles *Carabus clathratus*, *C. glabratus*, and *Harpalus iv-punctatus*, and especially the water-beetle *Agabus arcticus*, found in bog-pools on the slopes of Kippure, the only recorded Irish locality for this insect. They are mostly examples of a northern fauna, which is less numerously represented in the eastern than in the western highlands.

As in the case of certain Dublin plants, there are a few insects which would possibly not find a place in our local

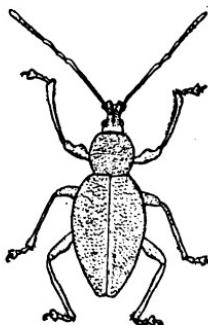


FIG. 15.—Pyrenean Weevil (*Otiorrhynchus auropunctatus*). Magnified 3 times. From Carpenter, in "Ireland, Industrial and Agricultural."

fauna but for the agency of the canals. The most interesting of these is the rare *Hæmonia appendiculata*, occurring in the Royal Canal, near Dublin. It has also been found in another part of the same canal further inland, and has, doubtless, been carried down from the lake district of the central plain.

The common English species *Silpha atrata* is entirely replaced in our district, as in Ireland generally, by a very distinct form called *Silpha subrotundata* by Stephens, both the black and brown varieties of which are almost equally common.

A list of the more interesting among the local species follows :— *Carabus glabratus* Payk. (Tibradden and Glenasmole, &c.); *C. clathratus*, L. (Enniskerry and Sugarloaf); *Calosoma inquisitor*, L. (found many years ago in the Powerscourt deer-park, the only known locality for this insect in Ireland); *Nebria complanata*, L. (Arklow sands); *Nebria Gyllenhali*, Sch. (abundant on Lugnaquilla, &c.); *Harpalus iv-punctatus*, Dej. (Sugar-Loaf Mountain); *Pterostichus picipes*, Duft. (taken by Mr. Tardy, has not been recently met with); *Calathus melanocephalus*, L. (the variety *nubigena*, Hal., is common on mountain summits); *Læmostenus complanatus*, Dej. (North Bull, Lambay, &c.; this species is probably introduced); *Cillenus lateralis*, Sam. (Baldoyle, &c.); *Bembidium anglicanum*, Sturm. (Dodder banks); *Trechus lapidosus*, Daws. (abundant in a cave on Lambay); *Lebia chlorocephala*, Hoff. (Woodenbridge); *Pelobius tardus*, Herbst. (near Rathdrum); *Bidessus minutissimus*, Germ. (River Camac, near Clondalkin, possibly brought down by the Grand Canal; the only previously known Irish localities are in the south-west); *Cælambus v-lineatus* (abundant); *Hydroporus Davisii*, Curt. (stream on Kilmashogue); *Agabus arcticus*, Payk. (bog-pools on Kippure); *Octhebius Lejolisi*, Muls. (in stagnant pools of salt-water near Greystones); *Xenusia uvida*, Er. (in same locality as the preceding); *Oxypoda Waterhousei*, Rye (Dundrum, in moss); *Phytosus nigriventris*, Chevr. (Baldoyle); *Diglotta mersa*, Hal. (local); *Tachinus elongatus*, Gyll. (Powerscourt); *Cafius fucicola*, Curt. (Killiney, Howth, &c.); *Lathrobium angusticolle*, Lac. (banks of the Dodder, near Firhouse); *Medon obsoletus*, Nord (Dundrum); *Deleaster dichrous*, Grav.; *Bryaxis Waterhousei*, Rye (Portmarnock salt-marsh); *Silpha iv-punctata*, L. (Dargle); *Silpha subrotundata*, Steph. (common); *Aphodius plagiatus*, L. (North Bull); *Melolontha hippocastani*, F. (Greystones and Poulaphuca); *Cetonia aurata*, L. (rare, has occurred at Howth and Lambay); *Telephorus darwinianus*, Sharp. (shore near Dollymount); *Strangalia aurulenta*, F. (Avondale); *Donacia thalassina*, Germ. (common in the Royal Canal); *Hæmonia appendiculata*, Panz. (found in small numbers in the same locality as the preceding); *Lema septentrionis*, Weise (local, Santry).

and Howth); *Phaleria cadaverina*, F. (Arklow sands); *Melandrya caraboides*, L. (Powerscourt); *Otiorrhynchus europunctatus*, Gyll. (locally common at Portmarnock, Santry, &c.); *Cenopsis Waltoni*, Schön. (Ovoca); *Polydrusus chrysomela*, Ol. (under stones on the shore near Bald Doyle, its food-plant *Artemisia* grows in the locality); *Liparus coronatus*, Goeze (Portmarnock, the only known locality for the species in Ireland); *Eubrychius relatus*, Beck. (in canals and ponds, Santry, &c.); *Magdalisa armigera*, Fourc. (Santry, on elms); *Rhopalomesites Tardyi*, Curt. (local in decaying holly and other trees; Powerscourt deer-park is a well-known locality for the species).

J. N. H.

NEUROPTERA.

Our knowledge of the distribution of the various groups of insects comprised under the name Neuroptera is largely due to the researches of J. J. F. X. King, who made several collecting tours in Ireland, and published the results in 1889.¹

As long ago as 1869, the late A. W. Foot published² a list, containing thirteen species of the Dragonflies observed by him during a season in County Wicklow. This list has not been subsequently increased, although it is likely that a few additional species remain to be discovered. Among those recorded by Dr. Foot are *Libellula cærulescens*, *Brachytron pratense*, and *Aeschna grandis*, all rather local insects in this country; indeed of the first-mentioned insect all the recent records are from the province of Munster. *Aeschna juncea* is common in suitable localities, and specimens are occasionally captured in the streets of Dublin. The beautiful dragonflies *Calopteryx virgo* and *C. splendens* are very local, the latter occurring in the Lucan demesne.

The wooded banks of the rivers Liffey and Tolka have

¹ "A Contribution towards the Neuropterous Fauna of Ireland," Nat. Hist. Soc., Glasgow, 1889.

² "List of Dragonflies obtained in County Wicklow," Proceed. Dublin Nat. Hist. Soc., vi., p. 31.

yielded some of our more local species of Neuroptera, notably *Osmylus maculatus*, apparently a rare insect in this country; also *Sisyra Dalii*, *S. terminalis*, and some of the delicate little flies in the genus *Hemerobius*, including *H. micans*, *H. lutescens*, and *H. nervosus*.

The absence from our district of certain common English insects of this order, such as the Snake-flies and Scorpion-flies, is noteworthy. A single species (*Panorpa germanica*) of the latter has recently been found for the first time in the south-west of Ireland.

Among the Stone-flies *Perla maxima* occurs, and its curious larva may be found commonly under stones in the bed of the river Dodder.

There are several Caddis-flies reported from our district that are not very common in Ireland generally. The following may be referred to here:—*Stenophylax stellatus* (Lucan); *Leptocerus bilineatus* (Lucan); *Cecitis notata*; *Tinodes aureola* (Howth); and *Glossosoma verna* (Lucan).

J. N. H.

HEMIPTERA.

Only within very recent years has the local distribution of these interesting insects received much attention in Ireland, and, as may be expected, our knowledge of the different groups contained in the order is very unequal. For instance, the "Plant-bugs" (Heteroptera) are comparatively well known, the Homoptera much less so, and the scanty records there are of those economically important insects the Aphids and scale-insects refer to a few widespread injurious kinds.

The late A. H. Haliday, with his usual zeal, formed a fairly representative collection of the Irish species of Heteroptera. He does not appear, however, to have published a detailed list of his captures—a fact to be regretted, as we know that he worked a good deal in the Dublin and Wicklow district.

Among the local species there are a few of considerable rarity. We may refer to *Salda Mülleri*, Gmel., which has been found in a boggy heath on the Dublin mountains.

A broad it seems to live on high moors, especially in Scandinavia. The rare plant-bug *Lygus atomarius*, Mey., occurs on conifers in the Lucan demesne, in company with its congener *Lygus rubricatus*.

Among the rarer species recorded from the district are the following :—*Picromerus bidens*, L. (taken by Dr. Power); *Acanthosoma dentatum*, De G. (frequent in Wicklow, often in company with *A. haemorrhoidale*, L.) ; *Metacanthus punctipes*, Germ. (Portmarnock sandhills) ; *Ischnorhynchus resedae*, Panz. (Dargle) ; *Cymus grandicolor*, Hahn (Santry) ; *Drymus brunneus*, Sahlb. (in woods, County Wicklow) ; *Gastromes ferrugineus*, L. (Santry) ; *Velia currens*, Fab. (the somewhat rare winged form of this common insect has been frequently found in the bed of the river Dodder) ; *Microvelia pygmaea* Duf. (Royal Canal, &c.) ; *Gerris costæ*, H. S. (occurs in pools in the mountain districts) ; *Nabis flavomarginatus*, Scholtz (both the apterous and winged forms are abundant) ; *Salda Mülleri*, Gmel. (Tibradden) ; *S. scotica*, Curt. (Bray River) ; *Chrysostemma alienum* H. S. (among wet shingle in the bed of the Dodder) ; *Microphysa elegantula*, Baer. (Lambay) ; *Teratocoris Saundersi*, D. & S. ; *Lygus atomarius*, Mey. (Lucan demesne) ; *Dicyphus errans*, Wolff. (Lambay) ; *Capsus laniarius*, L. (near Dublin, Dr. Power) ; *Globiceps dispar*, Boh. (Donabate, &c.) ; *Orthotylus concolor*, Kb. ; *Macrotylus Paykulli*, Fall. (Portmarnock) ; *Notonecta glauca*, L. (the dark variety, *fucata*, occurs in boggy places) ; *Corixa hieroglyphica*, Duf., and *C. Bonsdorffii*, Sahlb. (the latter species is abundant in the Royal Canal).

J. N. H.

ORTHOPTERA.

The species of Cockroaches found in Ireland are all apparently introduced forms, as the few native British Ectobias which occur in the southern counties of England have not been noticed in this country. The Common and German Cockroaches (*Blatta orientalis* and *Phyllodromia germanica*) are well established. The latter insect, which occurs both in woods and houses in Central Europe, abounds in many of the cages in the Zoological Gardens

and in other places in Dublin. The common American species *Periplaneta americana* has been abundant in a Dublin soap factory for many years. In the Glasnevin hot-houses *P. australasiae* and *Leucophaea surinamensis*, species of tropical origin, but now of almost cosmopolitan range, occur; and a pretty, green species of *Panchlora* is occasionally imported with bananas, though it has not become established here.

Only four kinds of Grasshoppers have been found in the district. The two species *Stenobothrus viridulus* and *S. bicolor* are common, while *Gomphocerus maculatus* occurs on Calary Bog in County Wicklow. One of the long-horned grasshoppers, *Leptophyes punctatissima*, has been found at Howth.

So far as we are aware, the Mole Cricket (*Curtilla gryllotalpa*) has never been found in our district; and the same may be said of the Field Cricket (*Gryllus campestris*). The House Cricket (*Acheta domesticus*) probably occurs in suitable localities.

The Common Earwig (*Forficula auricularia*) abounds, and the smaller and rarer species, *Labia minor*, has been found at Bray and Santry.

J. N. H.

APTERA.

The Bristletails and Springtails of the district have been collected and studied for several years past, but nothing has yet been published about them beyond a list of the species occurring on Lambay.¹ A number of the insects that have so far been found are of considerable distributional interest.

Thysanura.—*Campodea staphylinus*, Westw., is common in mould, and *Lepisma saccharina*, L., occurs in houses. *Petrobius maritimus*, Leach, is abundant on the tidal margin. *Premachilis hibernica*, Carp., belonging to a genus hitherto known only in southern Europe, was recognized last year on Lambay. It occurs also in County Wicklow,

¹ G. H. CARPENTER, "Contributions to the Natural History of Lambay. Apterata." Irish Nat., vol. xvi., 1907, pp. 54-6.

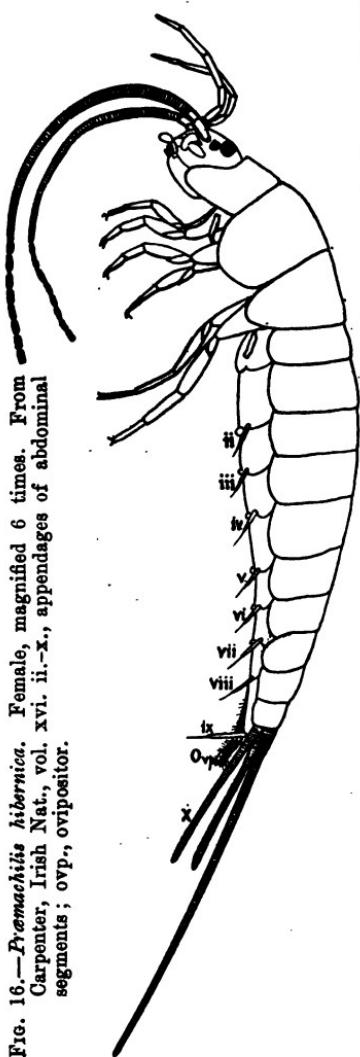


FIG. 16.—*Pyrenachilus hibernicus*. Female, magnified 6 times. From Carpenter, Irish Nat., vol. xvi. ii.-x., appendages of abdominal segments; opp., opipositor.

is widely distributed through Ireland, and has recently been found in Scotland and the north of England (fig. 16).

Collembola.—Among the springtails of the district are *Neanura muscorum*, Templ., *Onychiurus inermis*, Tullb., *O. armatus*, Tullb., *O. ambulans*, L., and *Aphoromma granaria*, Nic., which all occur in mould. *Anurida maritima*, Lab., is common on the seashore, often swarming on and around rock-pools at low water. *Xenylla maritima*, Tullb., has been found at Greystones, and *X. humicola*, Fab., a northern species, on the Lambay shore. The three last-named species are all haunters of the tidal margin. *Achorutes viaticus*, Linn., is common; it has been found in myriads at the sewage outfalls, and *A. armatus*, Nic., also occurs in the district. *Podura aquatica*, L., is widely spread in the usual situations.

Anurophorus laricis, Nic., is found in the district among moss. The most interesting springtails of the district are perhaps some of the species of *Isotoma*. *I. viridis*, Bourl., and *I. palustris*, Müll., are common everywhere, but the district has also yielded *I. minuta*, Tullb., *I. griseescens*, Schött., *I. arborea*, Lin., and

I. bidenticulata, Tullb. This last-named species (fig. 17) is found in colonies under stones in the mountain streams of Wicklow, as well as in the Comeragh Mountains, County Waterford, and the Mourne Mountains, County Down. Until its discovery in Ireland it was known only from arctic Europe and Asia, Spitzbergen, Franz Josef Land, and the Swiss

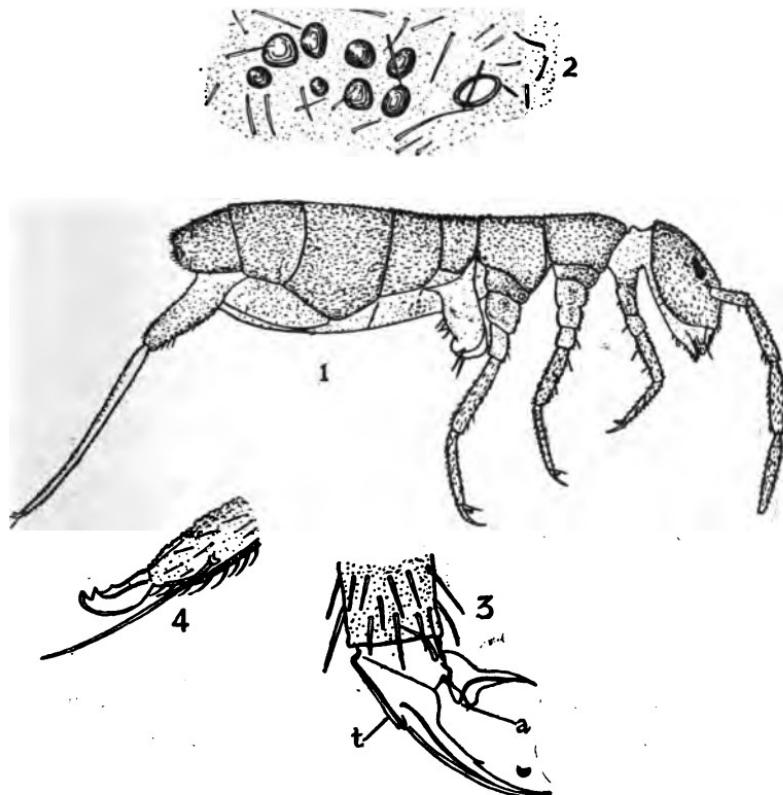


FIG. 17.—*Iotoma bidenticulata*. From Carpenter, Irish Nat., vol xvii.
1, side-view $\times 24$; 2, left ocelli and post-antennal organ $\times 300$;
3, hind-foot showing claw with tunica (*t*), and double empodial
appendage (*a*); 4, tip of dens with mucro.

Alps. *Orchesella villosa*, Geoff., and *O. cincta*, L., are both common in the district; so are *Entomobrya albocincta*, Templ., *E. muscorum*, Tullb., *Lepidocyrtus cyaneus*, Tullb., and *L. lanuginosus*, Gmel., *Tomocerus plumbeus*, L., and *T. longicornis*, Müll.

The Sminthurids of the district include *Sminthurus fuscus*, L., *S. viridis*, L., *S. aquaticus*, Bourlet (Lucan), and *Papirius ornatus*, Lubbock.

G. H. C.

CHILOPODA, SYMPHYLA, AND DIPLOPODA.

BY GEORGE H. CARPENTER, B.S.C.

But little attention has been paid to the "Myriapods" of the district. Almost all that is known of them may be found in a paper by R. I. Pocock.¹ The centipedes include *Lithobius forficatus*, Linn., *L. variegatus*, Leach, the latter especially common under stones in the hill-country, and *L. melanops*, Newp., *Geophilus carpophagus*, Leach, *Linotænia maritima*, Leach (Portmarnock shore), and *Stigmatogaster subterraneus*, Leach.

Scutigerella immaculata, Leach, not rare in mould, represents the Symphyla.

The Millipedes (Diplopoda) are more numerous. *Polyxenus lagurus*, Linn., occurs at Lucan, in Phœnix Park, and on Lambay; there can be no doubt that the species is indigenous. *Glomeris marginata*, Vill., is common. *Polydesmus gallicus*, Latzel, a south-west European millipede, unknown in Great Britain, is one of the most interesting Irish representatives of the "Lusitanian" fauna. *Atractosoma polydesmoides*, Leach, has occurred in gardens near Dublin. The local "snake millipedes" include *Blaniulus fuscus*, Stein, *B. venustus*, Meinert, *Julus britannicus*, Verhoeff, *J. punctatus*, Leach, *J. niger*, Leach, and *J. sabulosus*, Linn.

¹ R. I. POCOCK, "Notes upon some Irish Myriapoda." Irish Nat., vol. ii., 1893, pp. 309-312.

CRUSTACEA.

By G. P. FARRAN, B.A., STANLEY W. KEMP, B.A., AND W. M.
TATTERSALL, M.Sc.

DECAPODA.

About sixty species of Decapoda are now known from the neighbourhood of Dublin, and it does not seem probable that any very numerous additions will in the future be made to the list. J. R. Kinahan, about fifty years ago, devoted much time to the Irish Crustacea, and drew up a fairly complete list of the species found near Dublin. The majority of these have been again taken in recent years, and five or six additional kinds have been noticed. Mention is here made only of the rarer or more interesting forms.

Among the Oxystoma, two species of *Ebalia*, *E. tuberosa* (Pennant) and *E. Cranchi*, Leach, are not uncommonly found on the rough shelly ground in the vicinity of Killiney. *Atelecyclus septem-dentatus* (Montagu) is exceedingly scarce, and *Coryistes cassivelaunus* (Montagu), though local, is often very common. In certain localities the latter species is always present in the trawl, often in abundance; and frequently, after easterly gales, the North Bull strand may be found strewn with the unsavoury remains of numberless specimens.

Several species of Cyclometopa seem to be extremely rare. *Portumnas latipes* (Pennant) and *Perimela denticulata* (Montagu) have been recorded by Kinahan, but have not since been rediscovered. The former was found cast up on Merrion Strand after a heavy gale; while the latter was taken in Dalkey Sound. Judging by the number of records, *Xantho florida* (Montagu) is equally scarce; but it is possible that this would be disproved if the rocky shores near Dublin were more fully investigated. *Pilumnus hirtellus* (Linn.) has been recorded from Dalkey Sound and from Lambay, and has also been found clinging to wreckage inadvertently trawled in Skerries Bay; the species is probably not uncommon. *Gonoplax angulatus*:

(Pennant), of the section *Catametopa*, occurs very rarely, usually on muddy bottom.

Of *Oxyrhynchus*, *Eury nome aspera* (Pennant) is another scarce form ; but Kinahan on one occasion dredged five specimens on the Kish Bank. Of the two species of *Hyas*, *H. araneus* (Linn.) is much the rarer ; and similarly in the genus *Inachus*, *I. dorynchus*, Leach, is far less common than its congener *I. dorsettensis* (Pennant). *Macropodia (Stenorhynchus) longirostris* (Fabr.) is sometimes found in Lambay Deep ; this species is not uncommon on the trawling grounds north-east of Rockabill lighthouse, but is always restricted to a mud bottom and deep water.

Among the hermit crabs or *Paguridæ*, *Anapagurus levius* (Thompson) and *A. Hyndmanni* (Thompson) are frequently found on shelly ground, usually inhabiting *Turritella terebra* or *Natica Alderi*. *Eupagurus cuanensis* (Thompson) is sometimes taken in numbers in the neighbourhood of the Kish and Burford Banks ; it is almost invariably found living in the sponge *Suberites* ; and *Eupagurus bernhardus* (Linn.), which is of course most abundant, is very rarely found in the same association. Of the Galatheidæ, *G. intermedia*, Lilljeborg, is much the rarest form, although not uncommon further to the north ; *Munida bamfia* (Pennant) is distinctly rare, but large specimens are found now and again off the mouth of Dublin Bay. *Porcellana platycheles* (Pennant) has been recorded by Kinahan from Portmarnock.

It is strange that no species of Thalassinidea have been noticed in the neighbourhood of Dublin. All the forms are burrowers, and therefore of necessity rarely met with ; but *Calocaris Macandrea*, Bell, a blind species of the most delicate colouring, has been repeatedly trawled in the neighbourhood of Carlingford on a very soft mud bottom between thirty and forty fathoms. It is possible that this form also occurs near Dublin ; but such muddy ground as exists in water of a suitable depth is for the most part comparatively hard, and it is obvious that, unless the trawl can sink deeply into the soil, it stands a very remote chance of catching an animal of fossorial habits.

The fresh-water crayfish, *Astacus pallipes*, Lereboullet, has been found in many of the rivers and streams of County Dublin, but has not often been recorded. *Palinurus vulgaris*, Latreille, is supposed to have occurred in Dalkey Sound, but is evidently very rare. *Nephrops norvegicus* (Linn.), the "Norway Lobster," is locally known as the "Dublin Bay prawn," but within the Bay itself it is rarely, if ever, found. This species, when in condition, affords the most excellent eating, and considerable quantities are brought into Dublin by the steam-trawlers. It exists in Lambay Deep, and on the adjacent muddy ground; but its principal habitat lies between Rockabill and the Isle of Man. Here, in thirty fathoms or more, on a bottom of mud or muddy sand, the species is often trawled in astonishing numbers. The numerical disproportion which exists between the sexes in trawled samples is very remarkable, for females rarely average more than two per cent. of the total catch. This can only be accounted for by supposing that the females live more deeply buried in the mud than the males, with the result that the trawl passes over them, leaving the majority practically untouched.

All the remaining species belong to the Caridea or shrimps proper. Of these the abundant *Crangon Allmanni*, Kinahan, is interesting, owing to the fact that it was first described by its author from specimens caught in the neighbourhood of Bray. Of the other species of Crangonidæ, *Philocheras sculptus* (Bell), a scarce form of particularly beautiful and variable colouring, has been many times taken near Bray and in the neighbourhood of Dublin Bay. *Philocheras fasciatus* (Risso) and *P. echinulatus* (Sars) also deserve mention: the former is a rare littoral form, while the latter is not infrequently taken in deep water, often in company with *Pontophilus spinosus*, Leach.

Processa canaliculata, Leach (=*Nika edulis*, Risso) is not uncommon; very large specimens are sometimes found in Lambay Deep.

Athanas nitescens (Montagu), an interesting Alpheid, which is not infrequent on the west and south-west coasts of Ireland, has been very briefly reported by Kinahan from

the Dublin district, but in the absence of any confirmatory evidence, the record must be regarded with suspicion.

Caridion Gordoni (Bate) of the family Hippolytidae is a very scarce species; in colour it is very remarkable, for the whole animal is perfectly transparent, with a sprinkling of bright red pigment spots. *Spirontocaris Lilljeborgi* (Danielssen), another form, with very attractive colouring, is equally rare; it has been found off the Dublin coasts on a single occasion only, in Lambay Deep. *Spirontocaris pusiola* (Kröyer) and *S. Cranchi* (Leach) also occur, the former being always found in much deeper water than the latter.

Among the Pandalidae, *Pandalus Bonnieri*, Caulery, a species which, strangely enough, was only described as recently as 1895, is quite common outside the thirty-fathom line. Palæmonidae are sometimes to be found on sale in Dublin; samples which were examined were found to consist almost entirely of *Leander serratus* (Pennant). Kinahan has recorded *Palæmonetes varians* (Leach) from pools on Merrion Strand; but this does not seem a very likely habitat for a brackish water species, although it is quite probable that it occurs in the Dublin district.

The only species of Pasiphæidae, *Pasiphaë sivado* (Risso), is very rare in Dublin Bay, but is far from uncommon in deeper water; it may always be trawled in Lambay Deep. This form is known by the suitable name of the "ghost prawn," for in life it is perfectly transparent, with, here and there, a tinge of red; even the eggs are colourless or of the faintest green tone. When placed in water, the eyes are almost the only visible parts of the animal.

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S. W. K.

SCHIZOPODA.

The Schizopoda of the Dublin marine area have been very little studied, and the knowledge of the distribution of the various species¹ throughout the district is very far from complete. Nearly all the species mentioned below have been met with only in Dublin Bay and Kingstown Harbour; but most of them must be widely spread throughout the area wherever suitable conditions obtain.

One species, *Macromysis flexuosa*, has, however, been recorded from practically all over the district, even from the shores of Lambay. It frequents chiefly the Laminarian zone and rock-pools left by the receding tide.

Its two near relatives, *M. neglecta* and *M. inermis*, have been taken—the latter in some numbers in Kingstown Harbour, by means of a tow-net, especially at night-time. In the same place, and by the same means, two species of *Siriella*, *S. armata*, and *S. Clausi*; two of *Schistomysis*, *S. ornata*, and *S. spiritus*; and the diminutive *Hemimysis Lamorna*, have all been captured.

Gastrosaccus spinifer is quite common in the deeper water of the area round Lambay and Rockabill; but not infrequently it may be taken at night in Kingstown Harbour.

The most interesting Mysid found in the district is the "trumpet-eyed shrimp," *Macropsis Slabberi*. It has as yet been met with only in Kingstown Harbour; but it must be common throughout the area where the suitable conditions obtain, viz., slightly brackish water.

The Euphausians, or more purely pelagic Schizopoda, do not often frequent the shallow waters of the district; but they are abundant in the more seaward parts, in the deep water off Lambay and Rockabill. Four species are usually met with—the large *Meganyctiphantes norvegica*, its smaller relative, *Nyctiphantes Couchii*, *Boreophausia inermis*, and *Thysanoessa neglecta*. They are of great importance as food for the mackerel and herring.

W. M. T.

¹ E. W. L. HOLT and W. I. BEAUMONT, Sci. Trans. Roy. Dubl. Soc. (2), vol. vii., 1900.

CUMACEA.

Still less is known in the Dublin area of the members of this order of Crustacea than of the last. This is not to be wondered at, considering their peculiar habits. Females live entirely buried in sand or mud, and rarely, if ever, leave their haunts. They are captured, therefore, mainly in dredgings. Males, however, at night-time swim freely at the surface of the sea, and may then be captured often in great numbers, by means of tow-nets. Only five species are known to occur in the district¹; but this number must be increased when the area is more exhaustively explored.

From Kingstown Harbour three species are known—*Iphinoë trispinosa*, *Bodotria scorpioides*, and *Diastylis rugosa*.

In the area between Ireland's Eye and Howth Head, three species have also been taken—*Bodotria scorpioides*, *Lanaprops fasciata*, and *Pseudocuma longicornis*—while the last-named species has also been recorded from twelve fathoms of water off Balbriggan.

W. M. T.

ISOPODA.

Fresh-water forms are represented by a single species only, the widely distributed *Asellus aquaticus*, which may be met with in numbers in the canals, and probably in most fresh-water streams in the district. The terrestrial Isopoda or Wood-lice of Dublin have received special attention at the hands of the late J. R. Kinahan and R. F. Scharff. Consequently they are known fairly completely, thirteen out of a total of nineteen Irish species having been recorded from the county. Along all the stony shores about high-water mark, the largest of Irish Wood-lice, *Ligia oceanica*, is common. It is semi-marine in habit, and never occurs inland.

The most interesting species of the district is *Trichoniscus roseus* (fig. 18a), a beautiful light vermillion-coloured form,

¹ W. T. CALMAN, *Fisheries Ireland, Sci. Invest., 1904, i. [1905]*.

with a pale yellow stripe down its back. It is, however, rare, and was first found by Dr. Scharff, under damp cinders in his own garden, in Dublin. *Metoponorthus cingendus* (fig. 18b) was known from the mountainous districts of Dublin before it was found in England; while the closely allied *M. pruinosus* is met with only in the neighbourhood of Dublin city itself. Both these species are south European forms. Other rarities of the district are

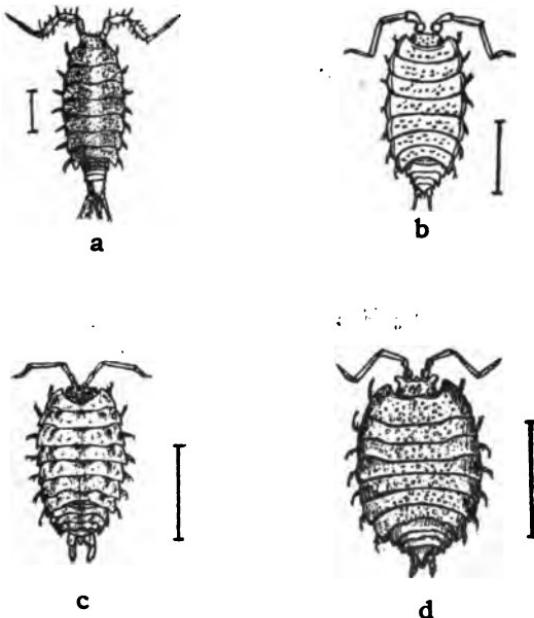


FIG. 18.—Dublin Woodlice: a. *Trichoniscus roseus*. b. *Metoponorthus cingendus*. c. *Porcellio pictus*. d. *P. dilatatus*. After Scharff, Ir. Nat., vol. iii.

Porcellio pictus (fig. 18c), found among rubbish in dry places, *P. dilatatus* (fig. 18d), which favours rather moist conditions, and *P. lavis*, which is one of the rarest of Irish Woodlice, found only in stable litter and at the foot of old walls.

Common and widely distributed forms include : *Trichoniscus pusillus*, *Oniscus asellus*, *Porcellio scaber*, *Philoscia muscorum*, and the "Pill Millipede," *Armadillidium vulgare*. The list is completed by *Cylisticus convexus*, found so far only in a disused quarry at Leixlip, and *Platyarthrus Hoffmannseggi*, likewise recorded only from Leixlip by Dr. Scharff.

The marine species include the destructive "gribble," *Limnoria lignorum*, which may be found boring any wooden structure which may be placed in the sea. Tow-nettings, taken at night in shallow water, yield larvæ of the curious *Gnathia maxillaris*; but the adults are entirely bottom-living, and are found chiefly on muddy bottoms. Among seaweed in shallow water, four species of *Idotea* are met with—*I. baltica*, *I. emarginata*, *I. linearis*, and *I. neglecta*, the last-named a species only recently described, but doubtless widely distributed. Between tide-mark on rocky shores, in crevices in the stones, *Nasa bidentata* and *Cymodoce truncata* occur; while another Sphæromid, *S. serratum*, is common under stones in slightly brackish water, accompanied sometimes by *Iæra marina*. The parasitic species *Bopyrus squillarum* is found frequently on the prawn *Leander serratus* throughout the district.

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W. M. T.

AMPHIPODA.

There are two fresh-water members of this order of Crustacea found in County Dublin—the common "Water-Flea," *Gammarus pulex*, usually found associated with the isopod *Asellus aquaticus* and the interesting "Well-Shrimp," *Niphargus kochianus*, by no means uncommon in wells in the neighbourhood of the city.

Among marine species of the family Hyperiidæ, the large and cosmopolitan *Hyperia galba* is frequently taken from under the umbrella of the large Trachymedusa *Rhizostoma pulmo*.

At extreme high-water mark on the sandy beaches of the area, the common "Sand-hopper," *Talitrus locusta*, may be found among decaying drift-weed cast ashore by the tide, while on rocky and stony shores it is replaced by *Orchestia littorea* and its ally *O. mediterranea*.

A boring Amphipod, *Chelura terebrans*, the friend and boon companion of the "Gribble" in its ravages on submerged timber-structures, is not uncommon in Dublin and Kingstown Bays.

Living in the holes bored by *Chelura* and *Limnoria* in timber, but in no way taking part in the boring, may be found the curious little *Corophium Bonelli*. A closely related but much larger species, *Corophium volutator*, lives in burrows honeycombed through the flats at the heads of Dublin and Kingstown Bays, wherever the water is slightly brackish. In similar situations lives *Gammarus marinus*, whose more strictly marine congener, *G. locusta*, is common in the outer parts of the bays, and near Lambay.

Two species, *Bathyporeia pelagica* and *Urothoe elegans*, the latter adorned with beautiful rose-coloured markings, resemble the Cumacea in the fact that, while males are constantly met with swimming freely in the water, the females, on the other hand, remain always buried in the sand. Correlated with this difference of habit, the males are furnished with large black eyes, while the eyes of the females are small and reduced. Such common species as *Melita palmata*, *Mæra oithonis*, *Amphithoe rubricata*, *Pleonexes gammaroides*, and *Cheirocratus Sundevallii* are frequent in the shallow waters of the district, either living among the seaweed, or under stones between tide-marks.

Perhaps the commonest Amphipod of tow-net gatherings in the bays of the district is *Paratylus Swammerdami*, followed closely in point of numbers by *Dexamine spinosa* and *Apherus bispinosa*. The aberrant family of the Caprellidæ is

represented by at least three species—*Phtisca marina*, frequent in tow-nettings at night; *Protella phasma*; and *Caprella linearis*, common on hydroid zoophytes.

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W. M. T.

ENTOMOSTRACA.

The Entomostraca of the Dublin district still offer a wide field of work to anyone who is interested in the subject, as of many of the groups, especially the littoral Copepods and the fresh-water Cladocera, very little is known.

The pelagic Copepoda, consisting for the most part of Calanoidea, are few in number, and are of sufficient interest to be enumerated in detail, as by their sensitiveness to differences in the salinity of the water they often afford indications of the hydrographical conditions prevailing in the Irish Sea. They belong almost entirely to that type of Plankton which is called Neritic, and which is found in the North Atlantic and the adjoining seas, in coastal waters of low salinity. Of these, *Calanus finmarchicus*, or *Calanus heligolandicus*, as it is called by many who reserve the better-known name for a larger northern variety or species, is fairly plentiful all along the coast, and *Pseudocalanus elongatus*, *Paracalanus parvus*, and *Acartia Clausi* are all common. Of the two species of Centropages, *C. hamatus* prefers a lower salinity, and consequently may be found in its greatest numbers close to shore; while *C. typicus* occurs farther out to sea, and even there is rather scarce. *Anomalocera Pattersoni*, the largest free-swimming species in the district, and easily recognized by its brilliant blue colour, is a surface-form, and occurs in summer in huge swarms. *Temora longicornis* is another species which at times appears in great swarms; but at all seasons it is plentiful. *Parapontella brevicornis* seems to thrive where an admixture of fresh water is present, and, though occurring

at times far out to sea, is to be looked for in plenty in the littoral region. *Isias clavipes* has somewhat similar habits, but is scarcer. The presence of *Metridia lucens*, which is occasionally found, may perhaps be taken to indicate an inflow of highly saline water from the south, as that species does not seem to be a native of the Irish Sea, though it is one of the commonest Copepods of the west coast of Ireland. *Candacia armata* also occurs irregularly; but its appearance does not, apparently, depend on questions of salinity. *Labidocera Wollastoni* is a scarce species, but seems to be as common in the Irish Sea as elsewhere. *Scolecithrix pygmaea* is sometimes taken; and *Scolecithrix hibernica*, which frequents the muddy bottom in the deeper parts of the Irish Sea, may be expected to occur.

Of the pelagic species other than the Calanidæ we may mention *Oithona similis* and *O. nana*. The latter is to be found in Kingstown Harbour, and probably elsewhere along the coast, the former in small numbers throughout the Irish Sea. These two species, though closely allied, show a marked difference in habit, *O. similis* being found in waters of moderate salinity, but avoiding the highly saline ocean, while *O. nana* is to be looked for where the salinity is low. *Enterpe acutifrons*, a distinctly pelagic species, is occasionally taken, and *Longipeda coronata* sometimes ventures out a short distance from shore.

Of the littoral Harpacticids only a few common species of no great interest are known. *Pseudocyclops obtusatus*, the most littoral of the Calanoidea in its habits, has been taken in Kingstown Harbour.

Several species of parasitic Copepods have been met with in the district. *Caligus rapax* is parasitic on several kinds of fish, and is sometimes taken swimming free. *Lepeophtheirus Thomsoni* infests the Brill, and *Lepeophtheirus Stromi* the Salmon and White Trout. *Cecrops Latreillei* has been recorded from the Sun-fish (*O. molas*), *Chondracanthus lophii* from the gills of the Angler-fish, and *Chondracanthus cornutus* from the Sole. *Lernæa branchialis* occurs on the gills of the Cod, as does *Anchorella uncinata* on those of the Whiting.

Of the marine Cladocera three out of the six Irish species have been found. *Evdadne Nordmanni* is at times

not uncommon, and *Podon Leuckarti* and *Podon intermedius* both occur. The former is frequently met with, but the latter is very scarce, and possibly should be regarded as a visitor from the west coast of Ireland, where it is common. The fresh-water Cladocera have not received much attention, but *Sida crystallina* may be mentioned as having been found near Dublin.

Of the Ostracoda which have been recorded from the Dublin coast, the majority are common all round the British Isles. *Cythere Roberti*, *Cythere angulata*, and *Cythere macallana* have, amongst others, been recorded from Dublin Bay, and *Potamocypris fulva* lives in the River Liffey.

The Cirripedes of the district are not well known. Of the Acorn-barnacles only a few of the common species, such as *Balanus balanoides*, *Balanus porcatus*, *Chthamalus stellatus*, and *Verruca stromia*, have been recorded. The stalked forms are permanently represented by *Scalpellum vulgare*, which is found in deep water, growing on the stalks of the Hydroid *Aglaophenia myriophyllum*; while *Lepas anatifera* has been observed on drift-timber. The parasitic *Sacculina carcini* is plentiful on the Green Crab (*Carcinus menas*) in Dublin Bay; and the remarkable *Alcippe lampas*, which lives completely buried in the substance of dead shells, has been taken in deep water in the shells of *Fusus antiquus*, which were inhabited by the hermit crab *Eupagurus bernhardus*.

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G. P. F.

ARACHNIDA.

By G. H. CARPENTER, B.Sc., M.R.I.A., and J. N. HALBERT, M.R.I.A.

PYCNOGONIDA.

The few records of this interesting group from Dublin Bay and the neighbouring waters are to be found in some recently published papers¹ and notes. A few additions can now be made to these through recently gathered material.

Nymphon rubrum, Hodge, is common in Dublin Bay from the shore to Lambay Deep. *Chatonymphon hirtum*, Fab., has been dredged in Dalkey Sound, off Howth, in Lambay Deep, and off the Kish and Burford Banks; this northern species is rare in Irish waters, and has not yet been found off the west coast. *Pallene brevirostris*, Hodge, and *Phoxichilidium femoratum*, Rathke, both occur commonly in Dublin Bay and the neighbourhood. *Anoplodactylus petiolatus*, Kröyer, and *Phoxichilus levis*, Grube, are scarcer; but *Ammothea echinata*, Hodge, and *Pycnogonum littorale*, Stroem, are abundant.

G. H. C.

PHALANGIDA AND CHERNETIDA.

Only a dozen fairly common species of Phalangida are known to occur in the district. *Liobunum rotundum*, Latr., and *L. Blackwallii*, Meade, are both common, together with *Phalangium opilio*, Linn. *P. purietinum*, Degeer, is less common, and *P. savatile*, Koch, is rare. *Platybunus corniger*, Herm., is fairly abundant, and so is that curious and interesting harvestman *Megabunus diadema*, Fab., whose mottled-grey colour accords well with the granite blocks of the hill-districts, where it is most often seen. *Mitopus morio*, Fab., is common everywhere. *M. alpinus*, Herbst., occurs on the hills. *Acantholophus agrestis*, Meade, is fairly

¹ G. H. CARPENTER, "On some Pycnogonida from the Irish Coasts." Sci. Proc. R. Dublin Soc., vol. viii., 1893, pp. 195-205, pl. xii. "The Marine Fauna of the Coast of Ireland": Part 6, Pycnogonida. Fisheries, Ireland, Sci. Invest., 1904, iv. [1905].

common, but *A. tridens*, Koch, is scarce. *Nemastoma lugubre*, Müll., abounds, and the unspotted, entirely black variety is sometimes seen. *N. chrysomelas*, Herm., has not been found nearer our district than County Carlow.

Nothing is known of the Chernetida of the district except the presence of two common species—*Obisium muscorum*, Leach, and *Chthonius Rayi*, L. Koch.

G. H. C.

ARANEIDA.

The spiders of the Dublin district are fairly well known, and several of the local species are of considerable interest to the student of animal distribution. Most of the available records are to be found in a general Irish list¹ published ten years ago by the writer of this notice. Since then further discoveries have been made, notably by D. R. Pack-Beresford, whose list of spiders collected on Lambay² is of exceptional value for so restricted a faunistic area. The wooded districts, both in the central plain and among the Wicklow hills, the coast sand-dunes, the tidal-margins, and the city houses have all yielded interesting species.

The single Irish species of the Atypidæ—*Atypus piceus*, Sulz—has not been seen in the immediate neighbourhood of Dublin, but its tubular silken nest has been found at Geashill in King's County. Of our native Dysderidæ, the handsome *Dysdera crocata*, Koch, is not rare in County Dublin and Wicklow, and occasionally enters houses, while *Harpactes Hombergii*, Scop., and *Oonops pulcher*, Templ., both occur in the district. *Segestria senoculata*, Linn., is of course common everywhere in suitable places.

Among the Drassidæ, *Prosthesina subterranea*, Koch, has been found at Powerscourt and on Lambay, and *P. pusilla*, Koch, at Tallaght; *Drassodes lapidosus*, Koch, near Shankill, and *D. troglodytes*, Koch, on the coast of County Wicklow and Lambay. *D. cupreus*, Bl., is common. The

¹ G. H. CARPENTER, "A List of the Spiders of Ireland." Proc. R. Irish Acad. (3), vol. v., 1898, pp. 128–210.

² D. R. PACK-BERESFORD, "Contributions to the Natural History of Lambay, Araneida." Irish Nat., vol. xvi., 1907, pp. 61–5.

local Clubionidæ include *Clubiona phragmitis*, Koch (Portmarnock), *C. pallidula*, Clerck (suburbs of Dublin), *C. grisea*, Camb. (Santry, County Dublin), *C. reclusa*, Camb., and *C. terrestris*, Westr. (common everywhere), *C. neglecta*, Camb. (Dublin Bay and Greystones), *C. lutescens*, Westr. (Dublin), *C. compta*, L. Koch (common), and *C. brevipes*, Bl. (Enniskerry), *Chiracanthium erraticum*, Bl. (Bray), *Anyphaena accentuata*, Walck. (widespread), *Zora spinimana*,



FIG. 19.—Dublin House-spider (*Tegenaria hibernica*) and snare.
(Photo. F. T. Eason.)

Sund. (Vale of Ovoca), *Micariosoma festivum*, Koch (Lambay), *Micaria pulicaria*, Sund. (Carrickmines), *Agroeca proxima*, Camb. (County Dub'in), and *A. celans*, Bl. (Devil's Glen, County Wicklow). Of the Thomisidæ, *Tibellus oblongus*, Walck, and *Philodromus aureolus*, Cl., are common. *P. dispar*, Walck, has occurred near Bray, and *Misumena vatia*, Cl., at several localities in County Wicklow; *Oxyptila trux*, Bl., and *O. horticola*, Koch, are both common; the

rare *O. flexa*, Cb., has occurred near Dublin, and *Xysticus ulmi*, Hahn, at Howth. *X. cristatus*, Cl., is abundant.

The Agelenidæ comprise some notable species. *Cryptoeeca sylvicola*, Koch, and *Argyroneta aquatica*, Cl., both occur near Dublin, the latter in the Royal Canal. *Tegenaria domestica*, Cl., is a common house-spider, and the large *T. parietina*, Fourc., has occurred once indoors at Grey-stones and once in Guinness's Brewery. Perhaps the most interesting spider of the district is *T. hibernica*, Camb., a large house-spider (see fig. 19) not unlike the English *T. atrica*, Koch, in appearance, but quite distinct from that species and closely allied to the Pyrenean and Spanish *T. nervosa*, Simon. *T. hibernica* is common in city and suburban houses, but it is occasionally seen out of doors; the type specimen was found at Glendalough, County Wicklow. Probably the spider is a member of the old south-western fauna that holds its own through having taken to an indoor life; it has also been found in Cork. *Agelenà labyrinthica*, Cl., is rare in the north of County Dublin, but *Textrix denticulata*, Oliv., abounds throughout the district, while *Hahnia elegans*, Bl., has been found on Lambay. Of the Dictynidæ, *Dictyna latens*, Fb., occurs in County Dublin, while the three species of *Amaurobius* are all common.

A large number of Theridiidæ occur in the district; only the more interesting and rarer can be mentioned here. *Ero furcata*, Vill., occurs both in Counties Dublin and Wicklow; *Epsinus truncatus*, Walck, has once been found at Ashford, County Wicklow. *Nesticus cellularius*, Cl., inhabits the Dowth tumulus near Drogheda, and has been found at Leixlip, County Kildare. *Theridion varians*, Hahn, *T. denticulatum*, Walck, *T. vittatum*, Koch, and *T. pallens*, Bl., all occur in County Dublin. *Enoplognatha thoracica*, Hahn, inhabits the North Bull, Dublin Bay. *Ceratinella breve*, Wid., *C. scabrosa*, Camb., *Araoncus humilis*, Bl., and *Lophocarenum nemorale*, Bl., have all been found in County Dublin; *L. stramineum*, Menge, was discovered last year on Lambay by Pack-Beresford: it had previously been unknown in the British Islands. *Tiso vagans*, Bl., *Savignia frontata*, Bl., *Diplocephalus speciosus*, Camb.,

D. fuscipes, Bl., *Tapinocyba subaequalis*, Westr., *Entelecara Thorelli*, Westr., and *E. trijrons*, Camb., all inhabit County Dublin. *Dicymbium nigrum*, Bl., has been found at Blessington, Co. Wicklow; *Walckenaera acuminata*, Bl., *Wideria antica*, Wid., and *Cornicularia unicornis*, Camb., are Dublin spiders; while the rare *Typhochestrus dorsuosus*, Camb., has been found at Laytown, County Meath; *Neriene rubens*, Bl., and *N. rubella*, Bl., *Dicyphus bituberculatus*, Wid., H., *D. cornutus*, Bl., *Stylothorax retusus*, Westr., *Gongylidium rufipes*, Sund., *Trachygynatha dentata*, Wid., *Erigone atra*, Bl., *E. dentipalpis*, Wid., and *E. longipalpis*, Sund., all occur in the district. *Micryphantes innotabilis*, Camb., has been found at Bray and on Lambay, and *M. viaria*, Bl., at Lucan. *Tmeticus bicolor*, Bl., is common; and *T. Huthwaitii*, Camb., is found on the mountains. *Hilaira reproba*, Camb., one of those interesting species that haunt the tidal margin, has been found on the North Bull and on Lambay; *Porhomma microphthalmum*, Camb., inhabits some of the Lambay caves. *Bathyphantes gracilis*, Bl., *B. dorsalis*, Wid., *B. pullatus*, Camb., *B. nigrinus*, Westr., *B. concolor*, Wid., and *B. variegatus*, Bl., all occur in the district. *Leptyphantes flavipes*, Bl., has been found at Glendalough, *L. cristatus*, Menge, at Enniskerry, *L. obscurus*, Bl., at Glenasmole, *L. pallidus*, Camb., on Lambay, and *L. leprosus*, Ohl., near Dublin and on Lambay. *L. cultus*, Camb., from Dublin, has never been discovered elsewhere. *Labulla thoracica*, Wid., occurs in several valleys among the Dublin and Wicklow Mountains. Noteworthy species of Linyphia are *L. peltata*, Wid. (Lucan), and *L. insignis*, Bl. (Enniskerry and Rathdrum). *Stemonyphantes bucculentus*, Cl., occurs at Malahide; *Drapetisca socialis*, Bl., in County Dublin and at Bray; *Bolyphantes luteolus*, Bl., at Calary, County Wicklow; and *Tapinopa longidens*, Wid., at several localities in County Dublin. Besides the common Tetragnathidæ, we have in the district *Pachygynatha Listeri*, Cl. (Rathdrum), *Tetragnatha Solandrii*, Scop. (Blessington and Lucan), and *T. obtusa*, Koch (Lucan). The Argiopidæ are fairly well represented; in addition to the two common species of *Meta*, *M. Menardii*, Latr., lives in sheltered

crevices of the Howth cliffs and in the Lambay caves. Noteworthy Aranei are *A. quadratus*, Cl. (Wicklow), and *A. Redii*, Scop. (Courtown, Co. Wexford).

Among the Lycosidæ, *Pisaura mirabilis*, Cl., is common in County Wicklow, but the handsome *Dolomedes fimbriatus*, Cl., widespread in the west and south-west of Ireland, seems to approach Dublin no nearer than King's County and Westmeath. *Lycosa perita*, Latr., abounds on the coast sandhills, and the great *L. cinerea*, Fab., is found in the stony beds of some Wicklow rivers. *L. leopardus*, Sund., has been found near Wicklow. Among the smaller hunting-spiders may be mentioned *Pardosa agricola*, Thor. (Bray); *P. monticola*, Koch (Portmarnock and Wicklow), and *P. lugubris*, Walck (woods of County Wicklow).

The Attidæ are but poorly represented in Ireland, the known spider-fauna of this family numbering only about a dozen species. Of these *Heliophanus flavipes*, Hahn, and *H. cupreus*, Walck, occur on the coast sandhills of County Dublin; *Ergane salcata*, Cl., has been found in some of the Wicklow glens; *Epiblemmum scnicum*, Cl., is common; while *Attus pubescens*, Fab., has lately been discovered on Lambay.

G. H. C.

ACARINIDA.

With the exception of the Mites living in fresh water, the Acarina have not been studied to any extent in Ireland. There are a few published records, chiefly of injurious species, such as the Root Mite *Rhizoglyphus echinopus*, a well-known enemy of hyacinth and other bulbs. Quite recently¹ an Oribatid Mite, *Lohmannia insignis*, Berlese (fig. 18), has been found, causing injury to roots of kidney beans in County Dublin, an interesting point about this mite being that it had only just been described as a new species by Berlese from another locality in Ireland.

The injurious Black Currant Mite (*Eriophyes ribis*) has been frequently reported from Dublin gardens, while the

¹ G. H. CARPENTER, Econ. Proc., Royal Dublin Soc., vol. i., 1905, p. 294.

results of the attacks of *Eriophyes rufis* are very generally in evidence on birch trees throughout the district.

A beginning has been made in the study of the family Oribatidae, and a list of the species occurring on Lambay was published last year.¹ The rarer species include *Oribata Lucasi*, Nic., *Scutovortex maculatus* (Michael), a species characteristic of the coast regions of western Europe, *Carabodes labyrinthicus* (Michael), common in moss, *Hermannia nanus* (Nic.), and *H. reticulata*, Thorell.

The Ants' Nest Mite *Trachyuropoda coccinea* (Michael) is locally abundant in nests of the small yellow Ant (*Lasius flavus*), with which insect also the beautifully sculptured mite *Urotrachytes formicarius* (Lubbock) lives on Lambay.

The mites found in fresh water have been rather thoroughly investigated, and a preliminary list² of the Dublin species was published a few years ago. The curious Mud Mite, *Linnochares aquaticus* (L.), is not uncommon in stagnant water, where may also be found numerous species of the large red mites of the genera Eulais and Hydrachna. In the first-mentioned genus the prevalent forms are *E. hamata*, Koenike, and *E. infundibulifera*, Koenike, while in the typical genus, Hydrachna, our commonest kinds are *H. scutata*, Piersig, and *H. conjecta*, Koenike. More than twenty species of the beautiful genus Arrhenurus have been recorded from the district; among the rare forms are *A. mediorotundatus*, Sig. Thor, *A. Freemanii*, Halbt.,³ described from specimens found in pools near Lucan, and since recorded from the Norfolk Broads, and *A. ornatus*, George, an interesting species which is common in the Britannic area, but has not yet been recorded from the Continent. *A. crenatus*, Koenike, abounds among Canadian Pond-weed in the Royal Canal. The old weed-grown ponds at Raheny have yielded some new and interesting species,

¹ J. N. HALBERT: "Acarinida of Lambay." Irish Naturalist, xvi., 1907.

² FREEMAN, D.: "Some Fresh-water Mites from Co. Dublin." Irish Naturalist, 1899, p. 157.

³ J. N. HALBERT: "Notes on Irish Fresh-water Mites." Zool. Anzeiger xxvi., 1903, p. 272.

notably *A. dilatatus*, Halbt., *A. cuspidifer*, Piersig, *A. sculptus*, Halbt., and *A. truncatellus* (Müller). In our mountain streams many torrent-loving forms occur, which are characteristic of the alpine districts of Europe; amongst these are *Aturus scaber*, Kramer, *Torrenticola anomala*, Piersig, *Sperchon setiger*, Sig. Thor, and *Ijania bipapillata*, Sig. Thor.

J. N. H.

ANNELIDA.

BY ROWLAND SOUTHERN, B.Sc.

CHÆTOPODA.

POLYCHÆTA.

No serious attempt has yet been made to work out the Polychæte fauna of the Irish coasts; and the published records are very scanty, and relate chiefly to very common shore-forms.

Haplobranchus æstuarinus, Bourne, a species living in mud, in estuaries, occurs in the River Liffey. *Capitella capitata*, Van Ben., is very common in the muddier regions of the Bay. *Lanice conchilega*, Malm., *Scoloplos armiger* (Müll.), and *Nerine coniocephala*, Johnst., are common in certain districts. *Pectinaria auricoma*, Müll., may be collected at low water at Skerries and Rush. Nearly all the Buccinum shells occupied by the Hermit Crab, *Eupagurus bernhardus* (L.), also shelter in the upper whorls the prettily-marked *Nereilepas fucata* (Sav.). *Dasychone bombyx* (Dal.), and *Thelephus cincinnatus*, Malm., *Nychia cirrosa*, Dal., and *Lagisca flocosa*, Pall., are obtained by dredging in a few fathoms. *Tomopteris helgolandica*, Gr., has been taken in Dublin Bay. Other common shore forms which have been recorded are *Lepidonotus squamatus* (L.), *Harmothoe imbricata* (L.), *Polynoe scolopendrina* (Sav.), *Evarne impar*. (Johnst.), *Sthenelais boa* (Johnst.), and *Phyllodoce viridis* (L.).

OLIGOCHÆTA.

The Oligochæta of the Dublin district are comparatively well known. The Lumbricidæ were worked out by Friend, and the other families are now being investigated. About sixty species are now known from this district, and the total number occurring is probably not far short of 200. In size they vary from 250–1 mm., and there are very few places where they cannot be found in large numbers. They are found in ponds, ditches, rapid streams, in soil, under the bark of trees, in manure, along the sea-shore, and in the roots of plants. One species at least, *Enchytraeus argenteus*, Mchlsn. (*E. parvulus*, Friend), is injurious to plants. The smaller species are often found in large numbers within a small area, and they are often curiously local in distribution. For instance, *Enchytraeus sabulosus*, South., is only found along the high-water mark, for about twenty yards, at Sandymount, and has not yet been taken in any other locality. On the other hand, some species are almost cosmopolitan, such as *Enchytraeus albidus*, Henle.

In the swiftly-flowing mountain streams, such as the River Dargle, *Æolosoma Hemprichi*, Ehrbg., occurs in the weeds, accompanied by several Naiads, such as *Chætopaster crystallinus*, Vejd. *Nais elinguis*, Müll., has been found in Sphagnum on Lambay. *Stylaria lacustris* (L.), *Tubifex tubifex* (Müll.) (*T. rivularum*, Auct.), and *Lumbriculus variegatus* (Müll.) occur in lakes, pools, and slowly-flowing streams. The interesting worm *Branchiura Sowerbyi*, described by Beddard from the *Victoria regia* tank at Regent's Park, occurs in a similar environment in the Glasnevin Botanic Gardens. Its original home has not yet been discovered, but is probably in South America.

On the shore, between tide-marks, a number of Oligochætes are to be found, belonging to the families Tubificidæ and Enchytræidæ. The Enchytræidæ are usually found under stones near the highest limit of the tide, whilst the Tubificidæ live in the sand down to low-water mark. Common forms are *Tubifex Benedeni* (Udek), *Clitellio arenarius* (Müll.), *Enchytraeus albidus*, Henle, *Marionina semifusca* (Clap.), and *Lumbricillus verrucosus* (Clap.); whilst *Enchy-*

træus sabulosus, Southern, as already remarked, has been found only at Sandymount.

A large number of species live among the roots of plants. Among these *Henlea hibernica*, Southern, *H. Dicksoni* (Eisen), and *H. ventriculosa* (Udek.) were found on Lambay, together with *Enchytraeus Bucholzii*, Vejd., *E. argenteus*, Mchlsn., and *E. minimus*, Bret. *Anachæta minima*, Southern, is so far only known from Lambay, where *Mesenchytraeus setosus*, Mchlsn., also occurs. The extensive genus *Fridericia* is well represented in our fauna, fourteen species being known from this district. They are often found in large numbers under the bark of fallen trees—a habitat which seems favourable to a large and varied fauna. *Fridericia glandulosa*, Southern, is known only from Lambay, from which place also *F. Bretscheri*, S., *F. minuta*, Bret., *F. polychæta*, Bret., *F. variata*, Bret., *F. bulbosa* (Rosa), *F. striata* (Levins), *F. connata*, Bret., *F. aurita*, Issel, &c., were obtained. *F. Ratzeli* (Eisen), and *F. ulmicola*, Friend, were recorded by Friend from Malahide. *F. Michaelseni*, Bret., and *F. Perrieri*, Vejd., are fairly common.

The Lumbricidæ of this district have been so well worked, that probably little remains to be discovered. One of the most interesting species is *Lumbricus Friendi*, Cognetti (*L. papillosus*, Friend), which was first described by Friend from specimens obtained in Dublin. It is very common in the south of Ireland and in the Dublin district, but has not been found in the north. It is absent from Great Britain, but is found at considerable altitudes in the Pyrenees and the Alps. *Eisenia veneta*, var. *hibernica* (Friend), was also described by Friend, from a Dublin specimen. It is evidently a very rare species, as it has not been found since in the British Isles. It occurs also in Italy. *Eiseniella macrura* was described by Friend from a single specimen found at Malahide. It has not been met with since. *Lumbricus festivus* (Sav.) is a common worm in the British Isles. On the Continent it is restricted to the North of France. Altogether, seventeen species and two varieties of the Lumbricidæ are known from the Dublin district; but, with the exception of the above-mentioned forms, they are all common and widely distributed.

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HIRUDINEA.

No work on Irish Leeches has appeared since the publication of R. F. Scharff's paper¹ on the fresh-water species. In this paper eight species are recorded as occurring in Ireland; but one of these, the Medicinal Leech (*Hirudo medicinalis*, L.), must be regarded as of very doubtful occurrence, no authenticated Irish specimens being known.

The remaining seven species are :—

<i>Piscicola geometra</i> (L.).	<i>Hemiclepsis tesselata</i> (Müll.).
<i>Glossiphonia stagnalis</i> (L.).	<i>Hæmopis sanguisuga</i> (L.).
<i>G. heteroclitia</i> (L.).	<i>Herpobdella octoculata</i> (L.).
<i>G. complanata</i> (L.)	

All these species occur in County Dublin, and some of them are very abundant. *Piscicola geometra* was taken on a Gudgeon in the River Dodder, and several specimens were found under stones in a brook near Stillorgan.

Of the Marine Leeches, only *Pontobdella muricata*, L., has been taken in this area.

CHÆTOGNATHA.

The only species recorded is *Sagitta bipunctata*, Krohn, said to have been common at Kingstown in June, 1885.²

¹ R. F. SCHARFF, "The Irish Fresh-water Leeches." Irish Naturalist, vol. vii. (1898), p. 188.

² HADDON, A. C., "Fauna of Dublin Bay." Proc. Roy. Irish Academy, (2), vol. iv., p. 529.

ROTIFERA.

Very little is known of the Rotifera of the district. The latest paper on the group is by Miss L. S. Glascott.¹ Most of the species mentioned or described were found in Co. Wexford. Among the Dublin records are *Floscularia algicola*, Hudson, *Notommata ansata*, Ehrb., *Proales sordida*, Gosse, *Furcularia forficula*, Ehrb., *F. gibba*, Ehrb., *F. Boltoni*, Gosse, and *Metopidia bractea*, Ehrb. *Conochilus volvox* was recorded forty years ago by W. Archer² from the Rocky Valley, Co. Wicklow.

MOLLUSCOIDEA.

By A. R. NICHOLS, M.A.

GEPHYREA.

Comparatively little is known as to the distribution of the Gephyrea, or Spoonworms, on the Irish coasts ; and, out of the fifteen species known to occur on the British shores, only four have been recorded from the neighbourhood of Dublin Bay.

The only species that is by any means common and generally distributed is *Phascolion strombi*, which has several times been dredged in Dublin Bay, at moderate depths, and generally in the dead shells of *Aporrhais pes-pelecani* and *Dentalium entalis*, but also occasionally in those of *Turritella communis* and *Ocinebra (Murex) erinacea*.

The late Professor J. R. Kinahan, who found several species of Gephyrea on the west coast of Ireland (principally on the coast of Clare), mentioned³ that *Syrinx granulosus* (?), McCoy, occurred plentifully in the sands of the Zostera banks in Dublin Bay ; and he included this species in the Report of the Committee appointed to

¹ L. S. GLASCOTT, "A List of some of the Rotifera of Ireland." *Sci. Proc. R. Dublin Soc.*, vol. viii., 1893.

² *Proc. Dubl. Microscopical Club*, 1867.

³ *Natural History Review*, vii., 1860.

dredge Dublin Bay.¹ It is very doubtful what species Kinahan referred to, as *S. granulosus*, McCoy, would seem to be identical with *Phascolosoma papillosum*, Thompson, which is probably a species of *Phycosoma*; and it is very improbable that any species of this genus occurs in Dublin Bay.

Specimens of *Priapulus*, thought by the late Professor McCoy² to be distinct from *P. caudatus*, and provisionally named *P. hibernicus*, were stated by him to be very common in the sand at low-water mark in Connemara, and occasionally found on the east coast of Ireland. There do not seem to be any sufficient reasons for regarding *P. hibernicus* as a distinct species; from the description and figures given by McCoy, it only differs from *P. caudatus* in having the body thicker and more robust, and the caudal appendage thicker and more bushy. *P. caudatus* was subsequently recorded from Dublin Bay, by Thompson³ and Kinahan; but I am not aware of any specimens having been found in this district in recent years.

BRACHIOPODA.

The Brachiopoda, whose shells are known as Lamp-shells, have very few representatives on the Dublin coast. This is not very surprising, when we consider the small number of British species extant to-day, of which only four are known to occur in shallow water off the Irish coast.

Argiope cistellula, and *Gwynia capsula*, are both mentioned by Jeffreys,⁴ as having been obtained in Dublin Bay by Waller.

A single specimen of *Waldheimia cranium* was stated by Turton⁵ to have been dredged up alive in Dublin Bay, and to have been placed in the Museum of the Royal Dublin

¹ British Association Report for 1860.

² Ann. Mag. Nat. Hist., xv., 1845.

³ "The Natural History of Ireland," vol. iv., Dublin, 1856.

⁴ "British Conchology," vol. ii., London, 1863.

⁵ "A Conchological Dictionary of the British Islands," London, 1819.

Society. The specimen cannot be traced; moreover, the locality is very doubtful, and is not repeated by Turton in a subsequent work on British bivalves.¹

The late William Thompson mentions² that a specimen of *Rhynchonella psittacea*, labelled "Dublin Bay," was observed by Mr. Alder and himself in the Museum of the Royal Dublin Society. It is very improbable that this northern species lives so far south as Dublin Bay, and the specimen, if correctly labelled, was probably semi-fossil.

POLYZOA.

Marine Polyzoa, sometimes called "Sea Mats," are fairly numerous on the eastern coast of Ireland; eighty species, or rather more than half of the number recorded from the Irish coast, have been found on the shores of Dublin and Wicklow; none of the species, however, are peculiar to Ireland.

As long ago as the middle of the eighteenth century, a Polyzoon—the Bird's Head Coralline (*Bugula avicularia*)—was mentioned by Ellis,³ as having been sent to him from the sea-coast near Dublin.

In 1840-1, the late Dr. A. H. Hassall⁴ published a catalogue of Irish Zoophytes, in which the whole of the Polyzoa enumerated, with one or two exceptions, were found by himself in the bays of Dublin and Killiney; and it is to the labours of Hassall that we are largely indebted for our knowledge of the group.

Two new genera, *Cycloum* and *Sarcochitum*, were described by him from specimens obtained in Dublin Bay; these genera are usually now regarded as not distinct from *Alcyonidium*. He also described several new species from specimens collected in the neighbourhood of Dublin Bay; some of them are now known to be identical with previously described species, but the following were

¹ "The Shells of the British Islands," London, 1822.

² "The Natural History of Ireland," vol. iv., Dublin, 1856.

³ "Contributions towards a Natural History of the Corallines," London, 1755.

⁴ Ann. Mag. Nat. Hist., vi. and vii., 1840-1.

regarded by Hincks¹ as distinct:—*Cellaria sinuosa*, *Cribrilina punctata*, *Schizoporella linearis*, *S. auriculata*, *Mucronella ventricosa*, *Tubulipora lobulata*, and *Alcyonidium polyoum*. *Crisia aculeata*, also described by Hassall, is now generally regarded as a distinct species; but *Alcyonidium polyoum* is sometimes believed to be identical with *A. mytili*.

Specimens of Polyzoa, obtained in Dublin Bay by Miss Ball and others, were mentioned by Thompson,² and, on the last occasion of the meeting of the British Association in Dublin, a list of Polyzoa from the neighbourhood was compiled by Mackintosh³ from collections by McCalla, Hassall, Mackintosh, and Grant.

In later years Haddon⁴ collected at Malahide and Kingstown; and Duerden⁵ at Laytown and Rush and in Dublin Bay. During the last three years, Polyzoa have been obtained on the coasts of Dublin and Wicklow by Colgan and Nichols; the former worked at Skerries and in Dublin Bay, and the latter at Lambay⁶ and on the Wicklow coast, principally at Bray and Greystones.

In Ireland the following appear to have hitherto been recorded only from the Dublin district:—*Actea truncata*, by Haddon; *Bugula turbinata* and *B. purpurotincta*, by Hincks; *B. murrayana*, on dead bivalves, &c., from deep water, by Johnston⁷; and *Crisia ramosa*, by Duerden.

As far as is at present known, in addition to the Dublin district, the distribution in Ireland of *Bugula plumosa*, *Flustra carbacea*, *Membranipora Lacroixii*, *M. aurita*, *Membraniporella nitida*, *Schizoporella spinifera*, *S. auriculata*, *Phylactella labrosa*, *Mucronella ventricosa*, and *Tubulipora lobulata* is confined to the north-eastern coast, and of *Flustra papyracea*, *Bowerbankia caudata*, and *Barentsia gracilis* to the southern coast.

¹ "A History of the British Marine Polyzoa," London, 1880.

² "Natural History of Ireland," iv., 1856.

³ "British Association Guide to the County of Dublin," 1878.

⁴ Proc. Royal Irish Acad. (2), iv., 1886.

⁵ Proc. Royal Irish Acad. (3), iii., 1893, and Irish Naturalist, iii., 1894.

⁶ Irish Naturalist, xvi., 1907.

⁷ "History of British Zoophytes," 2nd ed., London, 1847.

Some interesting fresh-water Polyzoa may be found in the neighbourhood of Dublin. Specimens of the widely distributed *Plumatella repens* have been obtained, and Allman¹ records the following species:—*Lophopus crystallinus*, from a pond in the Zoological Gardens, Phoenix Park; *P. emarginata*, from the River Dodder; *P. fruticosa*, *Cristatella mucedo*, *Fredericella sultana*, and *Paludicella Ehrenbergi*, from the Grand Canal. *C. mucedo* is abundant in a pool adjacent to the Grand Canal, near Clondalkin, about five miles from Dublin; colonies of *Fredericella* and *Paludicella* have also been found in the same pool by Mr. Willoughby Dade.

NEMATHELMIA.

BY ROWLAND SOUTHERN, B.S.C.

The Nemathelminia of this district, except the common parasites of domestic animals and other vertebrates,² are practically unknown. *Gordius violaceus*, Baird, has been recorded from Lambay.³ *Mermis albicans*, v. Sieb., has also been found in County Dublin. The destructive *Tylenchus devastatrix* is found in the district, *Aphelenchus fragariae*, Bos, has occurred near Bray in strawberry plants, and *Tylencholaimus minimus*, De Man., near Dublin in roots of the Sweet Pea.

NEMERTINEA.

BY ROWLAND SOUTHERN, B.S.C.

The two chief papers on Irish Nemertines are those of H. L. Jameson and W. I. Beaumont. In the paper of the former there are a few species recorded from the Dublin area. The commonest shore-forms are *Amphiporus*

¹ "A Monograph of the Fresh-water Polyzoa," London, 1856.

² O'B. BELLINGHAM, "Catalogue of Irish Entozoa," Mag. Nat. Hist., vol. iv., 1840; Ann. Mag. Nat. Hist., vol. xiii., 1844.

³ SOUTHERN, R., "Nematomorpha of Lambay." Irish Naturalist, vol. xvi., 1907, p. 84.

lactifloreus (Johnst.) and *Lineus ruber* (Müll.). The latter species has several colour varieties, of which the deep green form is most frequently met with. *Lineus lacteus* (Rathke) occurs in small numbers on the South Bull. The only other Irish record of this species is by Beaumont, who found it at Valencia. *Emplectonema Neesii* (Orst.) has been found between tide-marks at Skerries. *Prostoma (Tetrastemma) candidum* (Müll.) and *P. vermiculus* (Quatr.) live at depths of a few fathoms. The latter was obtained from Malahide Inlet. It was also recorded by Beaumont from Valencia. At greater depths (10 to 20 fathoms) several other species have been obtained. Of these *Tubulanus superbis* (Köll.) was dredged in 10 fathoms off Howth. *Tubulanus annulatus* (Mont.), *Prostoma flavidum* (Ehrbg.), and *Œrstedia dorsalis* (Abildg.) are common in the Bay at these depths. *Micrura purpurea* (Dalyell) and *M. fasciolata*, Ehrbg., were obtained in 18 to 18 fathoms off Howth Head. The latter was also taken in 6 to 7 fathoms in Dalkey Sound. *Amphiporus dissimilans*, Riches, was taken in 7 fathoms off Howth. This interesting species has only been recorded from British waters. It is regarded by Bürger as synonymous with *A. lactifloreus*, but it exhibits marked differences in structure and habitat from this species.

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PLATYHELMIA.

BY ROWLAND SOUTHERN, B.Sc.

TURBELLARIA.

No work has yet been published dealing with the Turbellaria of the Dublin district. At least three species of land planarians occur. Of these, *Rhynchodemus terrestris*,

Müller, is fairly abundant in damp localities, though it is not often found, owing to its retiring habits. *Rhynchodemus Scharffi*, V. Graff., was first found in a hothouse at Blackrock. It has since been found by Dr. Scharff under a log, in the open country, at Ballymote, County Sligo, thus strongly confirming his previously expressed opinion that it is indigenous in Ireland. *Placocephalus kewense* (Moseley) has been found in the Botanic Gardens, Glasnevin, and in several other similar places, where it had evidently been introduced. Probably several other species remain to be discovered.

In most of the rapid streams *Polyclelis cornuta*, Johnson, and *P. nigra*, Müller, are very abundant. *Planaria alpina*, Dana, is not restricted to the mountain streams, but occurs commonly on the lowlands. Both the brown and black forms of *Polyclelis nigra* are common. In still waters and slowly moving streams, *Dendrocaelum lacteum*, Müller, *Planaria polychroa*, O. Sch., and several other species occur. The only fresh-water Rhabdocœle yet identified is *Microstoma lineare*, Müller, from the River Dargle, at Powerscourt.

Between tide-marks, a number of minute Rhabdocœles occur, the commonest being *Monotus fuscus* (Oersted), *M. lineatus* (Müller), and *Plagiostoma vittatum* (Fr. and Leuk.). The two former are very common at Sandymount, whilst the latter has been taken at Howth. *Leptoplana tremellaris* (Müller) is common in Dublin Bay, ranging from high-water mark down to twenty fathoms. It is sometimes found in the upper whorls of whelk-shells, inhabited by the Hermit-crab *Eupagurus bernhardus*. The Triclad *Gunda ulvae* (Oersted) occurs in great numbers under stones on the shore at Killiney Bay and at Howth. A single specimen of *Cycloporus papillous*, Lang, was obtained by Mr. Colgan from eight fathoms in Dalkey Sound.

TREMATODA AND CESTODA.

No attempt has been made to enumerate the parasitic flat-worms of the district since Bellingham's catalogue,¹ published sixty years ago, which contains very little information as to localities. The common flukes and tape-worms of the domestic animals will be found recorded there, together with a number of species from Fishes and Birds.

ECHINODERMATA.

By A. R. NICHOLS, M.A.

The Echinodermata are divided into seven classes, two of which—Blastoidea and Cystoidea—are extinct: representatives of the other five classes—Crinoidea (Feather-stars), Holothuroidea (Sea-cucumbers), Asteroidea (Starfishes), Ophiuroidea (Brittle-stars), and Echinoidea (Sea-urchins)—are found living on the coasts of Dublin and Wicklow. Our knowledge of the distribution of the species in the district is principally derived from Forbes's "History of British Starfishes," Thompson's "Natural History of Ireland," vol. iv., and a paper on the "Distribution of the Irish Echinodermata," by J. R. Kinahan.² Lists of the species found in Dublin Bay and its vicinity are given by Hassall,³ and in the Reports of the Committee appointed to dredge Dublin Bay, drawn up by Kinahan.⁴

In recent years specimens have been collected on various parts of the coast or on Lambay Island by Mackintosh,⁵ Haddon,⁶ Colgan,⁷ Nichols,⁸ &c.

¹ O'B. BELLINGHAM, Catalogue of Irish Entozoa. Ann. Mag. Nat. Hist., vols. xiii., xiv., 1844.

² Natural History Review, vi. (Proc.), 1859.

³ Ann. Mag. Nat. Hist., ix., 1842.

⁴ British Association Reports for 1859, 1860.

⁵ British Association Guide to the County of Dublin, 1878. Proc. Roy. Irish Acad. (2), iv., 1884.

⁶ Proc. Roy. Irish Acad. (2) iv., 1886.

⁷ Irish Naturalist, xvii., 1908.

⁸ Irish Naturalist, xvi., 1907.

Out of a total of 58 species found in shallow water round the coast of Ireland, 31, or rather more than half, have been found in the Dublin district; none of the species is, however, confined to the district, nearly all being generally distributed in suitable localities round the coast.

CRINOIDEA.

The only member of this class found off the coast is the Rosy Feather-star (*Antedon bifida*), which is especially abundant off Ireland's Eye and in Dalkey Sound.

HOLOTHUROIDEA.

A few specimens of Sea-cucumbers, belonging to five species, have been recorded from the district, but none of them can be said to be common. Perhaps the most interesting is *Synapta inhaerens*, of which a specimen, three inches in length, was found many years ago on the beach at Balbriggan after a storm, and is recorded by Thompson; specimens have since been found at Malahide and Sandy-cove.

The brown variety of the Sea-Gherkin (*Cucumaria lactea*) has lately been dredged in Dalkey Sound by Colgan.

ASTEROIDEA.

This class is well represented in the district, more species of Asteroidea being found on the Dublin Coast than of any other class of Echinodermata. The only species found in shallow water on the Irish Coast, and not in the Dublin district, are *Luidia ciliaris* and *L. Sarsi*, which seem to be confined to the southern and western shores of Ireland. The Common Starfish (*Asterias rubens*) is very abundant; the large and handsome *A. glacialis*, which has larger spines, arranged in regular rows on the arms, and the small form *A. hispida* have also been found.

¹ Ann. Mag. Nat. Hist., xv., 1845.

Henricia sanguinolenta and the common Sun-star (*Solaster papposus*) are generally distributed and abundant; but the Purple Sun-star (*Solaster endeca*) and *Stichaster roseus* have only occasionally been obtained; large specimens of *S. endeca* have been dredged on a few occasions in Dublin Bay.

Asterina gibbosa is generally distributed; *Porania pulvillus* has been recorded from the east coast of Ireland by Wright and Greene¹; and a specimen of *Palmipes placenta* was stated by Thompson to have been dredged about seven miles off the Dublin coast; *Astropecten irregularis* has also been dredged off Dublin Bay.

OPHIUROIDEA.

The only Brittle-star that calls for special mention is *Ophioactis Balli*; this was named by Thompson,² after the late R. Ball, who dredged a few specimens in Dalkey Sound. This species is usually found in comparatively deep water, and has of late years been often dredged off the west coast of Ireland. Seven other species of Brittle-stars are found in the district, all of which are common and generally distributed round the Irish coast.

ECHINOIDEA.

The Common Sea-urchin (*Echinus esculentus*) and the small Purple-tipped Sea-urchin (*E. miliaris*) are generally distributed and abundant; the common Heart-urchin (*Echinocardium cordatum*) also abounds in suitable localities; specimens of the Rosy Heart-urchin (*E. flarescens*) were mentioned by Forbes as having been taken in Dublin Bay by R. Ball. The Purple Heart-urchin (*Spatangus purpureus*) and the small Green Pea-urchin (*Echinocymus pusillus*) are occasionally obtained off the coasts of Dublin and Wicklow.

¹ Brit. Assoc. Rep. for 1858.

² Ann. Mag. Nat. Hist., v., 1840.

CALYCIFERATA.

By J. RA. TROWBRIDGE, B.Sc.

The earliest account of the Ciliophora of the Dublin coast was published more than one hundred and fifty years ago. In 1771 a collection, which included some Gymnoblastic Hydroids from Dublin Bay, was sent to John Ellis, who described them a few years later in his "Essay towards a Natural History of the Ciliophores and other Marine Protostomous of the Animal Kingdom found on the Coasts of Great Britain and Ireland." It may be interesting to recall the subsequent history of these earliest known British Hydroids, as it was by a study of them that Ellis *erroneously* concluded that the Hydroids were members of the animal kingdom. Ellis describes how he mounted these Hydroids with sea-weeds on cards to form such "natural history Landscapes" that he was requested to prepare "some Pictures of this kind" to send to the Princess Royal of Wales, in order that "the young Princesses might amuse themselves in disposing of these beautiful Procreations in the like picturesque Manner." About eighty years elapsed before another account of the Dublin Ciliophores was published; but during the last fifty years many additions have been made to the list, which now includes some one hundred and thirty species.

HYDROZOA.

The west coast of Ireland is richer than the east in Gymnoblastic Hydroids; yet some interesting and rare forms have been found off the Dublin coast, notably in Dalkey Sound—a spot which seems to be particularly favourable to members of this group. *Syncoryne frutescens*, described by Allman from a specimen taken at Kingstown, has not since been rediscovered off the coast. It is interesting to notice that both hydroid and medusoid forms of *Corymorphia nutans* have been found at Kingstown. The only other Irish locality known for this species is Valencia, where, however, the medusa stage alone has been taken. *Tubularia cornucopiae* and *Eudendrium capillare* have been found once or twice off the coast. The rare *Wrightea*

arenosa has been taken at Rush. No species of Bougainvillea, Perigonimus, or Podocoryne have yet been obtained off the Dublin coast.

Two fresh-water genera, *Cordylophora* and *Hydra*, are represented. The specimens of *Cordylophora lacustris*, from which the genus and species were described, were found many years ago in the Grand Canal Docks, Dublin. The species has not since been noted in Ireland, but has been discovered in England and on the Continent. *Hydra viridis* and *H. fusca* have been found in various ponds in County Dublin.

Among the Calyptoblastea, the commoner species of *Sertularia*, *Halecium*, *Diphasia*, and *Antennularia* are often found entangled in large masses washed up on the shore. They call for no special remark, as they are equally abundant at almost every part of the coast. Many of the smaller and more delicate members of the Campanulariidae are also common. The rarer species are *Campanularia angulata*, *C. neglecta*, once taken in Dalkey Sound, and *C. caliculata*. *Lafœa dumosa* and *Calycella syringa* are common. *Lafœa pocillum* and *Calycella pygmæa* also occur, but, owing probably to their small size, have not often been recorded. *Campanulina turrita*, taken at Rush and Dalkey, deserves mention. *Thuiaria thuia* and *T. articulata* have been obtained occasionally. The latter was one of the species in the famous Ellis collection. Several species of *Aglaophenia* and *Plumularia* are to be found, the rarest being *Plumularia frutescens*.

The Anthomedusæ and Leptomedusæ have not received very much attention. Among the former the following may be mentioned:—*Hybocodon prolifer*, *Margelis principis*, *M. ramosa*, *Tiara octona*, and the medusa of *Corymorphia nutans*, previously mentioned. A few Leptomedusæ occur—*Thaumantias hemisphærica*, *Melicertidium octocostata*, *Dipleurosoma typicum*, and several others. All these medusæ have been recorded once, or at the most twice, for the Dublin coast; and many of the records date from fifty years ago. It would be interesting to see what information would be brought to light by fresh investigation of these medusæ.

SCYPHOZOA.

Large specimens of *Pilema octopus* may frequently be seen floating at the surface of the water, or washed up on the beach. *Aurelia aurita* is fairly common, and *Chrysaora isosceles*, *Cyanea capillata*, and *C. Lamarcki* have been taken in Kingstown Harbour. *Depastrum cyathiformis* and *Lucernaria campanulata* have once been found, the former in Dalkey Sound, the latter at Bray.

ANTHOZOA.**ALCYONARIA.**

Alcyonium digitatum is the only member of this group which is common off the coast. *A. glomeratum*, a rarer species, has been found in Dublin Bay. *Eunicella Cavolini*, better known under the name *Gorgia verrucosa*, was once obtained off Lambay. Another Alcyonarian, *Virgularia mirabilis*, has been taken more than once off the north-east coast of Ireland. It will probably some day be added to the Dublin fauna.

ZOANTHARIA.

The family Zoanthidæ is represented by only one species, *Epizoanthus Wrighti*, which was described from specimens taken in Dalkey Sound. It has not since been noted. *Edwardsia timida* and *Halcampa chrysanthellum* have been found at Malahide, and a larval stage of *Halcampa*, which is parasitic on a Leptomedusa, has been taken in Kingstown Harbour. *Peachia hastata* is known to occur at Dollymount. *Actinia equina*, *Metridium senilis*, and *Anemonia sulcata* are abundant in the rock-pools. Several species of *Sagartia* are fairly common. *Cylista viduata* has been taken several times at Howth and Malahide.

MADREPORARIA.

Small specimens of *Caryophyllia clavus* have frequently been dredged off the coast. *Sphenotrochus Wrighti*, taken many years ago in the Dublin area, has recently been found off Dalkey Island by N. Colgan.

CTENOPHORA.

This group has been almost entirely neglected, as far as the Dublin coast is concerned, for the last fifty years. *Pleurobranchia pileus* is known to occur, and is probably abundant at certain seasons. *Bolina norvegica* and *Beroe ovata* have been recorded from Lambay and Kingstown Harbour.

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PORIFERA.

BY JANE STEPHENS, B.S.C.

The Sponges of County Dublin have, on the whole, received very little attention from naturalists. The period lasting from about 1840 to 1878 was the most productive of work on the Dublin Sponges. During the thirty years that have elapsed since the last meeting of the British Association in Dublin, the Sponges have again been neglected, and but few species have been added to the list then published. About twenty-seven species are known to occur in the

Dublin area, and these are, for the most part, common and widely-distributed forms.

The class Hexactinellida is entirely unrepresented. This is to be expected, as the hexactinellid sponges belong to the deep-sea fauna. No Tetractinellida have as yet been found; they may, however, be looked for, as some members of the group occur in shallow water, although the majority seem to be most abundant at greater depths.

Among the Calcareous Sponges, *Sycon compressum* and *Sycon coronatum* are everywhere common in the rock-pools. *Leucosolenia botryoides* and *Clathrina coriacea* have occasionally been found, and *Leucandra nivea* has been taken at Rush.

Only about twenty-two species of the Demospongia have been recorded. Large specimens of *Chalina oculata* have been obtained in Dublin Bay. Of the numerous species of *Halichondria* and *Reniera*, only *Halichondria panicea*, *Reniera cinerea*, and *R. simulans* have been recorded. Probably other species occur, but have been passed over, owing to their inconspicuous appearance and to the difficulty of determining them. A variety of *Gellius angulatus* has been obtained off Lambay. This is the first record for Ireland (with a doubtful exception of a species on the west coast) of this widely-distributed genus, which extends from Arctic to Antarctic regions. Of the many species of *Esperiopsis*, only *E. fucorum* has been noted. *Ophlitaspongia seriata* is to be found, but not very abundantly, at Howth, Ireland's Eye, and Lambay. *Hymeniacidon sanguineum* and *H. carunculum* are to be met with. *Axinella stuposa* and *Raspailia hispida* have been taken in deeper water off the coast. The encrusting form of *Ficulina ficus*, which invests shells inhabited by hermit-crabs, is common, and may often be found washed up on the shore. This sponge is described under the names (among many others) of *Hymeniacidon suberea*, *H. ficus*, *H. farinarius*, and *Suberites domuncula*. The confusion arises partly from the fact that the characteristic microscleres were overlooked in the type-specimens of *Hymeniacidon suberea*. Later writers identified *H. suberea* with the *Suberites domuncula* of the Mediterranean. A more thorough examination has proved the existence of

microscleres in the type-specimens of *H. suberea*; and it has recently been shown that these various forms, which have been described under so many names, and which differ so much in external appearance, should be united under the name *Ficulina fucus*, a sponge quite distinct from the true *Suberites domuncula*, which possesses no microscleres. The common boring-sponge, *Cliona celata*, is found off the coast.

Among the most interesting sponges are those that inhabit fresh water, although sufficient attention has not yet been paid to them. Hitherto only *Euspongilla lacustris* and *Ephydatia fluviatilis* have been found in County Dublin. They are to be met with in ponds, and occur plentifully in the canals. These two fresh-water sponges are very common on the Continent of Europe and in the United States of America. Another common fresh-water sponge of Europe and North America, *Spongilla fragilis*, ought to be specially looked for in this district. Some few years ago the interesting discovery was made that two or three other species of fresh-water sponges, which for long were thought to be confined to the United States, occur in Ireland. So far they have only been found in some of the western counties.

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PROTOZOA.**FLAGELLATA, CILIATA, RHIZOPODA, &c.**

By J. BAYLEY BUTLER, M.A.

In the following article I take the province of Leinster as the district with which I propose to deal, since some records in counties other than Dublin and Wicklow are of great interest, and, indeed "Parish records" in the distribution of Protozoa would be of very little use in our present state of knowledge of this subject.

Records have been made incidentally by some students of other groups; but no one has systematically studied Irish Protozoa (except Foraminifera) during the last twenty years. Only five species of marine Protozoa (except Foraminifera) have been recorded for Leinster, and not many more fresh-water Ciliata. In 1906 W. and G. S. West included records of fourteen species of Protozoa in their account of the plankton of some Irish lakes; but as these are outside Leinster, they cannot be dealt with here. From 1860 until 1890 a small band of workers in the Dublin Microscopical Club, under the leadership of the late William Archer, F.R.S., were very energetic in collecting and exhibiting fresh-water organisms, both plant and animal. Unfortunately they frequently omitted to record the exact locality from which the specimens had been obtained, or even in some cases to state whether they were Irish or not. In consequence, much of their valuable work was from the faunistic standpoint wasted. Archer founded a considerable number of genera and species on Protozoa he collected in Ireland. Some of his species have since proved to be identical with previously described species, and they only serve to swell the list of synonyms; others he named, but gave no description or figure (his arduous duties in the reorganization of the National Library leaving him little time for scientific work), and these of course are lost, but a very fair number remain as universally admitted species. Amongst the latter is that most interesting form *Chlamydomysa labyrinthuloides*, which he first found in the cells of the bog-moss (*Sphagnum*) in a pool at

Multyfarnham, County Westmeath. He was attracted by the diffuse red colour of the pool, and on careful examination he found the organism in the leaf-cells of Sphagnum. Archer made repeated attempts to trace the life-history of this interesting form, but, much to his disappointment, without success. He first exhibited the form at the Dublin Microscopical Club on the 31st January, 1870, under the title of "A Problematic Organism of Labyrinthulean Affinity," and subsequently he described and figured it.

Next to Archer, the late Dr. John Barker did the best work on Protozoa in Ireland; amongst other records he founded the species *Diplophrys Archeri* on Irish specimens. A few scattered records were made by other members of the Club.

In the following notes I give the names as recorded by the finder; I have not attempted to trace the synonymy, since, though easy in some cases, it would be impossible in others, through lack of sufficient description.

In County Wicklow the two most productive localities are Carrig, or "Carrick," Mountain (1252 feet), about five miles from Wicklow town, and Calary Bog, near Lough Tay. Archer found interesting species also in Glenmalure and on Bray Head; while further inland, in the Rocky Valley at the base of the Great Sugarloaf, Barker made a few valuable records. Six species are mentioned as "occurring in the County Wicklow," no exact locality being given.

Archer seems to have paid a good deal of attention to County Westmeath. As has already been mentioned, it was from this county that he described *Chlamydomyxa*; and he recorded six other species from it.

There are fifteen species recorded by Archer and his colleagues as "new to Ireland," but no locality is given. It is probable that they were found in Leinster, since, in most cases, when specimens were found elsewhere, the fact was definitely stated. These species are included in the following list, without locality.

Finally, Professors H. H. Dixon and J. Joly made an investigation (1896-97) of organisms occurring in the plankton of Killiney Bay. They recorded five species of Protozoa.

FLAGELLATA.

- Drepanomonas dentata**, *Frese*.—County Westmeath.
Monas consociata, *Frese*.
Synura uvella, *Ehrb.*.—Calary Bog, County Wicklow.
Phalansterium intestinum, *Ciensk.*.—Rocky Valley,
 County Wicklow.

CILIATA.

- Tintinnus campanula**.—Killiney Bay plankton.
T. annulatis, *Clap. and Lach.*.—Killiney Bay plankton.
T. conicus, *Dixon and Joly*.—Killiney Bay plankton.

LABYRINTHULIDEA.

- Chlamydomyxa labyrinthuloides**, *Archer*.—County Westmeath.

HELIOZOA.

- Acanthocystis turfacea**, *Carter*.—County Wicklow.
A. pertyana, *Archer*.—Calary and Carrig, County Wicklow.

- Actinophrys sol**, *Ehr.*
A. Eichornii, (*Ehr.*).

RADIOLARIA.

- Dictyocha trifenestra**.—Plankton of Killiney Bay.

RHIZOPODA.

- Amœba diffuens**.—Rocky Valley, Co. Wicklow.
A. villosa, *Wallich*.—Rocky Valley, Co. Wicklow.
A. quadrilineata, *Carter*.
Amphitrema wrightiana, *Archer*.—Glenmalure,
 County Wicklow.
Amphizonella vestita, *Archer*.—County Westmeath.
Arcella vulgaris, (*Ehr.*).
A. aculeata, (*Ehr.*)
Cyphoderia margaritacea.—*Schlumb*.
Cytophrys haekeliana, *Archer*.—Calary and Carrig,
 County Wicklow.

- C. oculata**, *Archer*.—Calary and Carrig, County Wicklow.
Clathrulina elegans, *Ciensk.*—Calary.
Diaphoropodon mobile, *Archer*.—Glenmalure.
Difflugia thalassia, *H. Dixon and Joly*.—Killiney Bay plankton.
D. oblongata, *Ehrb.*—Calary and Corrig.
D. carinata, *Archer*.
D. triangulata, *Lang*.
Diplophrys Archeri, *Barker*.
Euglypha alveolata, (*Duj.*).
Heterophrys Fockii, *Archer*.—County Wicklow, County Westmeath.
H. myriopoda, *Archer*.—Carrig.
H. marina *Hertw.* and *Less.* (?).—Calary (in fresh water).
Microgromia socialis, *Hertw.*—Glenmalure.
M. mucicola, *Archer*.
Pleurophrys spherica, *Clap.* and *Lachm.*—County Wicklow.
P. amphitremoides, *Archer*.—County Wicklow.
P. fulva, *Archer*.—County Wicklow.
Pamphagus mutabilis, *Bailey*.—County Westmeath.
Pampholyxophrys punicea,¹ *Archer*.—Carrig and Calary, County Wicklow; County Westmeath.
Raphidiophrys viridis, *Archer*.—Carrig, County Wicklow; County Westmeath.
R. elegans, (*Hertw. and Less.*)
Quadrula irregularis, *Archer*.
Trinema acinus, *Dujardin*.

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¹Archer says that the form is identical with *Hyalolampe fenestrata*, Greef. He claims priority, as he states that his account was published at least a week before that of Greeff.

in the plankton of Dublin and Killiney Bays." *Sci. Proc., R. Dublin Soc.*, vol. viii., p. 748.—W. and G. S. WEST : "Plankton of some western Irish Lakes." *Trans. Roy. Irish Acad.*, vol. xxxiii., sect. B., 1906, p. 77.—J. CASH, "British Freshwater Rhizopoda and Heliozoa." London (Ray Soc.), 1905.

FORAMINIFERA.

By JOSEPH WRIGHT, F.G.S.

Dr. H. B. Brady tells us, in his Introduction to the "Challenger" Report, that Foraminifera, as a rule, are not of pelagic habit, 98 or 99 per cent. of recent species (including the whole of the porcellanous and arenaceous groups and the bulk of the hyaline) inhabiting the sand or mud of the sea-bottom, possessing neither swimming nor floating powers. On the other hand, a small number of forms, belonging to eight or nine genera, live either in part or entirely on the surface of the ocean, or in mid-water. These few species occur in extraordinary abundance; and their shells form the large proportion of the entire mass of the sea-bottom deposit.

It is well known that a sandy sea-bottom is not so congenial for foraminiferal life as that which is more or less muddy. When Mr. F. P. Balkwill and I were dredging for Foraminifera in 1881-82, several hauls were taken at or near Lambay Deep, at distances not far apart. As the materials of three of these were of somewhat different character, they are interesting for comparison. The first (mud), from 45 to 50 fathoms, yielded 108 species; the second (mud and sand), 48 fathoms, 88 species; the third (sand), 40 fathoms, 62 species. These gatherings are also interesting as showing how the character of the sea-bottom may influence the distribution of the Arenacea. Three of these forms, *Hyperammina elongata*, *Reophax scorpiurus*, and *Haplophragmium pseudospirale*, were all abundant in the first dredging; in the second only the two first were present, both rare, while in the third all had disappeared. These dredgings added materially to our knowledge of the Foraminifera of this part of our coast.

Out of the 148 species and varieties obtained, thirteen were new to the Britannic fauna, Lambay Deep alone yielding 124 species. This fertility is largely due to the fine oozy mud already referred to.

At Lambay Deep the greater part of the rarer forms were met with, the most noteworthy being *Spiroloculina acutimargo*, *Cornuspira foliacea*, *Haplophragmium agglutinans*, *Lagena curvilineata*, *L. striato-punctata*, *L. castrensis*, (?) *Rhabdogonium tricarinatum*, *Marginulina glabra*, *Pullenia quinqueloba*, and *Discorbina tuberculata*, this last having also been met with in the shallow water of Dublin Bay. In the Bay were also obtained the two rare species *Anmodiscus shoneanus* and *Pullenia sphæroides*.

A number of sandy-shore gatherings were examined; but, with the exception of a specimen of *Polymorphina spinosa*, they contained little of special interest. A few additional species have been found since the report was published in 1885, the most interesting being *Haliphysema Tumanowiczii* from between tides at Dalkey Island by Prof. Haddon, and *Pulvinulina concentrica* and *Polystomella craticulata* from Lambay Deep material by myself.

I recently received, through the kindness of Mr. E. W. L. Holt, Inspector of the Irish Fisheries, some samples of dredged material taken off the Irish coast, five coming from or near Lambay Deep. Two of these samples were composed of mud from depths of 32 and 44 fathoms respectively; and while both yielded Foraminifera in quantity, from the first sample (32 fathoms) was obtained the exceptionally large number of 144 species and varieties. The most notable specimens obtained from these two gatherings were *Haplophragmium latidorsatum*, *Bolivina nobilis*, *Allomorphina trigona*, and *Nonionina boueana*.

The following notes are on some of the rarer forms found:—

Lagena castrensis, Schw.—The only Britannic examples of this species are two from Lambay Deep, and one found at Southport by Dr. Chaster (Southport Soc. Nat. Sci., vol. i. (app.), p. 62, 1890–91). It is not unusual in Australian gatherings and a few adjacent places.

Allomorphina trigona, Reuss.—A specimen of this

very rare form was found near Lambay Deep; depth, thirty-two fathoms. As a recent species it has only been met with in a few of the "Challenger" soundings in the Pacific.

(?) **Rhabdogonium tricarinatum** (*d'Orb.*).—The few examples found at Lambay Deep were all restricted to two chambers, whilst well-grown specimens of this species have usually a much larger number. D'Orbigny's figure is not satisfactory; it is blunt at the oral end, and with little doubt represents a broken specimen. I have a well-grown perfect specimen with thirteen segments and pointed oral end from the Pliocene near Cannes.

Polymorphina spinosa, *d'Orb.*—Two examples of this rare form were found in the Dublin gatherings. It had previously been found by Mrs. Shone in the estuary of the Dee. It occurs fossil in the Miocene formation.

Nonionina boueana, *d'Orb.*—One small typical specimen has been found at Lambay Deep. The shell figured under this name (*Trans. Roy. Irish Acad.*, vol. xxviii., *Science*, pl. xiii., fig. 2) shows the double row of sutural orifices characteristic of *Polystomella arctica*, and should be referred to this latter species.

Polystomella craticulata (*F. and M.*).—One small specimen of this very interesting form was obtained at Lambay Deep. This is essentially a shallow-water tropical form, and often attains a comparatively large size.

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HISTORY AND ARCHÆOLOGY.

THE ENVIRONS OF DUBLIN.

BY F. ERLINGTON BALL, M.R.I.A.

THE beauty of the surrounding country, combined with its maritime position, gives to the metropolis of Ireland a charm possessed by few of the larger municipalities of the United Kingdom. Within the comparatively narrow bounds of the county to which Dublin gives its name there is a variety of scenery such as is seldom found in similar limits; and the proximity of this scenery to the crowded streets has often caused the situation of the city to be an object of envy to the inhabitants of towns less fortunate in their environs. In the bay, which affords entrance to the port of Dublin, the blue waters of the Irish Sea merge in the gorse which covers the promontory of Howth, and in the wooded slopes which rise above the suburbs of Clontarf and Merrion. A few miles to the south there stretches along the coast from Dalkey Island to Bray Head the crescent-shaped shore of Killiney Bay, comparable, some persons have thought, to that of Naples; and to the north there lie the picturesque form of Ireland's Eye, the silvery sands near Malahide estuary, and the green islands of Lambay and Holmpatrick. Inland the landscapes are no less attractive. To the west, near Lucan, the valley of the Liffey reveals a scene of sylvan richness, the hill of Athgoe, near Newcastle Lyons, a panorama of the Meath and Kildare lands, and the plain of the Phoenix Park wide prospects of the Dublin mountains. To the north, again, the district, known from Danish times as Fingal, is covered with fields of golden corn and verdant meadows; and to the south the mountain torrent of the Dodder rushes through heather-clad moorland.

Owing to its extension during the last century, Dublin

has lost some of its more immediate rural environment, and lands which a hundred years ago were devoted to grass and tillage are now covered by the chain of suburbs which surrounds the city. Besides these suburbs, Clontarf, Drumcondra, Glasnevin, and Kilmainham to the north and west, and Rathmines and Pembroke to the south and east, there are along the sea-border, in the south-eastern direction, the populous urban districts of Blackrock, Kingstown, Dalkey, and Killiney, and inland from these the villa-covered lands of Foxrock, Stillorgan, and Dundrum. But building has not been so continuous as to destroy the natural features of the country, and in some cases seems to intensify their effect. The handsome terraces and houses, and the massive churches with their pointed spires, make a pleasing foreground to the trees and hills which rise above them; and the busy existence of the residents throws into strong contrast the pastoral peacefulness which pervades the greater part of the county. As one traverses more than two-thirds of the roads, the impression is of life in which agriculture is the only interest. Here and there the house of some one engaged in the occupations of the city meets the eye; but the villages are small, and the only considerable centres besides those already mentioned are the sea-side resorts of Howth, Malahide, Skerries, and Balbriggan, with the inland one of Lucan. Nowhere is the smoke of factories seen to darken the sky; and the only employment besides husbandry is such as the fisheries on the coast and the quarries in the mountains provide.

As regards relics of past ages, the metropolitan county forms no exception to Ireland in general; and in all directions destruction, change, and decay have laid heavy hands upon objects of archeological and antiquarian interest. The principal remains are those relating to primeval and early Christian times; and rock-monuments and primitive churches are to be seen in places denuded of every trace of inhabitants from those periods until the present. Of medieval architecture, domestic as well as ecclesiastical, the specimens are few and unimportant; and of the buildings of the Jacobean period, when in Ireland the transition took

place from fortified dwellings to those designed for comfort and convenience, there is not a perfect example. But the converse is found to be the case in dealing with the history of the county; and it is not until Dublin became, under the Anglo-Norman settlement, the seat of government, that material for the historian begins to accumulate. In such literature as has been published with relation to earlier times, there are few references to the lands now included in County Dublin, which were then no more important than those of many of the territories into which Ireland was divided; and until more progress is made in the examination of Irish manuscripts it is not possible to write with authority on that portion of the county's history.

Before the Christian era, the chief event of which there is record in connexion with the lands now embraced in the county is the construction of a dun on Dalkey Island. It has been attributed to the dim age which saw the commencement of Milesian rule in Ireland, and the place-name, which means thorn island, originated possibly in the prickly circumvallations of the fortress. But some further light is thrown on the condition of the district in pre-Christian times by a legendary tale, the scene of which is laid within the limits of the present county. This saga, one of the oldest and most important in Irish literature, has formed the subject of Sir Samuel Ferguson's well-known poem of "Conary," and has been also recently translated for English readers by an eminent Irish scholar.¹ It describes the pillage and destruction by a predatory band from Britain of a palatial residence which stood close to the River Dodder, and not far from the sea. On the owner, one Da Derga, was imposed the obligation of providing shelter and hospitality for all comers; and at the moment when the marauders descended upon the house no less a person than the king of Ireland was his guest. In the tale we see the king with an immense train of attendants advancing across the plain where Dublin now lies, by a great road which led from Tara, the seat of supreme

¹ "The Destruction of Da Derga's Hostel," by Whitley Stokes, *Revue Celtique*, vol. xxii., *passim*.

royalty, to the south ; and we are told how the marauders, who saw his approach from the Hill of Howth, steered their "thrice fifty vessels" for the Merrion shore, on which the ships were cast by a mighty wave with a shock that made Da Derga's house tremble to its foundation. Two place-names, Booterstown and Bohernabreena, still remain to prove that in this tale there is fact as well as imagination. Booterstown, which means the town of the road, is the name of a district between Dublin and Kingstown, and indicates the line of the road from Tara along the coast ; and Bohernabreena, which means the road of the court, is the name of a district in the mountains near the Dodder, and indicates the former existence along that river of a road on which an important dwelling stood. The discovery near the famous village of Donnybrook, close to the Dodder, of a mound under which a number of persons killed by violence had been buried has led some persons to identify this place as the site of Da Derga's house, and the skeletons as those of the inmates who fell in the massacre that occurred. But this is open to doubt, and the swords and other implements, which were found under the mound and are now in the National Museum, are attributed to a much later period.¹

At that time the northern half of County Dublin, which lay in Meath, then one of the provinces of Ireland, formed part of a territory called Bregia, and the southern half, which lay, as now, in Leinster, formed part of a territory called Cualann. In the portion of the county comprised in the former territory, few traces of the prehistoric age remain, a cromlech at Howth and another in the Phoenix Park being the chief relics. But the whole range of the Dublin mountains and their immediate vicinity, in what was once the territory of Cualann, are rich in rock-monuments. At Mount Venus (fig. 20) and Larchfield near Rathfarnham, at Kiltiernan, at Glendruid near Cabinteely, and at Shanganagh near Killiney, great cromlechs, some of

¹ See Paper by William Frazer, F.R.C.S.I., Proceedings of the Royal Irish Academy, sec. 2, vol. ii., pp. 29–55 ; and cf. "A Social History of Ancient Ireland," by P. W. Joyce, LL.D., vol. ii., p. 172.

them quite exceptional in size, are to be seen,¹ and at Killiney there is a stone erection called the Druid's Judgment Seat, which marks the site of three cromlechs enclosed in a stone-circle, near which, in the eighteenth century, a number of skeletons were found (*cf.* p. 246). In the hilly country near Tallaght, Saggart, and Kiltiernan, raths,



FIG. 20.—Dolmen, Mount Venus, Co. Dublin.

(Photo. by T. J. Westropp.)

giants' graves, stone-circles, cairns, and pillar-stones abound. Further to the west, near Crumlin, many cists have been found, one of which is exhibited in its original

¹ See "On the Orientation of some Cromlechs in the neighbourhood of Dublin," by Professor J. P. O'Reilly, *Proceedings of the Royal Irish Academy*, ser. 3, vol. iv., p. 589; also W. Borlase, "Dolmens of Ireland," pp. 376-395.

condition in the National Museum¹ (fig. 21); and at Lucan there is an interesting sepulchral chamber.



FIG. 21.—Urn in cist, Greenhills, Co. Dublin. (From Proc. R. I. Acad.)

¹ See "On a Cist and Urns found at Greenhills," by Lieut.-Colonel G. T. Plunkett, Proceedings of the Royal Irish Academy, ser. 3, vol. v., p. 338.

On the districts now included in the County Dublin Christianity took an early and firm hold. St. Patrick, when he arrived on his evangelizing mission, is said to have sailed along the coast of the county, and to have touched at Malahide as well as at the island of Holmpatrick, on which his name is impressed; and it is not improbable that he proceeded inland, since the original designation of the church at Donnybrook, and of another in the northern part of the county, indicate that these sacred edifices owed their origin to him. The dedications of the ancient churches in the county show that St. Patrick was followed by a number of holy men, through whose teaching and example the truths of Christianity were disseminated; and the number of religious establishments in Celtic times of which trace is found is most remarkable. In the country rising over Killiney Bay, at a place called Rathmichael, some portion of the cashel which surrounded a Celtic monastery, a ruined church, and the base of a round tower are to be seen; and it is possible to picture the establishment of which they formed part. In the centre stood the church, originally a small quadrangular edifice of Cyclopean masonry, with a low, square-headed doorway in the western end, and one or two narrow openings for light; and near its south-western corner rose the belfry and place of refuge for the ecclesiastics in time of distress, a tall, graceful tower, circular in shape, tapering upwards, from a base some fifty feet in circumference, and terminating in a conical roof of stone. Round the church were scattered bee-hive huts, in which the monks lived; and the whole was enclosed by a wall some seven feet high, with an entrance through a covered gateway. Not far from Rathmichael, at a place called Tully, two high crosses and a ruined church mark the site of a similar monastery; and across the mountains, to the west, lay one of great renown, at Tallaght, and another at Clondalkin, where its tower—one of the few round towers still in a perfect condition—is a prominent object. On the northern side of Dublin, Celtic monasteries are known to have existed at Glasnevin and Finglas, as well as at Swords and Lusk, where round towers are to be seen (figs. 80 and 81); and monks were

also established on the islands of Ireland's Eye, Lambay, and Holmpatrick, where they found freedom, away from distraction and interruption, for literary work and meditation. Of the churches of that period the most striking example is one at Killiney (fig. 27), which is now enclosed on every side by villas of the most modern kind, but which stood originally on a bare cliff overhanging the sea; and others may be seen not far from it, on Dalkey Island (fig. 22), at Kill-of-the-Grange, and at Kiltiernan, as well as on the northern side of Dublin, at a place called Donabate.¹

The invasions of the Northmen, inspired as they were by hatred of Christianity as well as thirst for plunder, fell with terrible severity on the Celtic monasteries, and in the possession of a round tower lay the only hope of safety for the unhappy inmates. First, the island monasteries were burned, and then those on the mainland, such as Lusk and Clondalkin. The Scandinavian settlements which succeeded the invasions specially affected the northern portion of the present county, which became known as Fingal, the territory of the white strangers, and from these settlers Howth, Ireland's Eye, Lambay, Holmpatrick, and a village called Bald Doyle obtained their present names. In the southern part of the county a large tract near Rathmichael belonged to the sons of Thorkil, and the place-names Dalkey and Clondalkin are in their present form of Danish origin. On the great battle between the Irish and the Danes, in 1014, which is known as the Battle of Clontarf, but which extended over ground now covered by the northern half of the City of Dublin, it is impossible to dwell here; and we must pass on to the arrival of the Anglo-Norman invaders, when the local historian begins to find firm ground.

So far as the lands in the county of Dublin are concerned, the Anglo-Norman conquest was complete—a conquest in reality, and not, as elsewhere in Ireland, only one in name. The partition of the lands which ensued is clearly

¹ See "On the Churches of Dalkey, Kill-of-the-Grange, Killiney, and Ireland's Eye," by Professor J. P. O'Reilly, in *Proceedings of the Royal Irish Academy*, vols. xxiv., Sect. C, p. 195, and xxv., Sect. C, p. 107.



FIG. 22.—St. Begnet's Church, Dulkey Island.
(Photo. by T. Mason, Dublin.)

defined in the ancient records, and before the close of the twelfth century we find Anglo-Norman magnates established in every part of the area now comprised in the county. To the south of Dublin the principal settler was Walter de Rideford, Lord of Bray, one of the most brave and noble of Strongbow's followers, who was given lands near Donnybrook, as well as near the place from which he took his feudal title ; and, further inland, Milo le Bret of Rathfarnham and Hugh de Barnewall of Drimnagh (fig. 23) upheld Anglo-Norman rule. To the north of Dublin, ancestors of the St. Lawrences of Howth and of the Talbots of Malahide shared with a number of other invaders the spoils which fell to the victors ; and to the west, Hugh de Tyrell, Lord of Castleknock, the site of whose castle may be seen near the Phoenix Park, was unrivalled in the extent of his possessions. In what is now the south-western corner of the county, the Crown reserved certain lands which became known as the royal manors of Newcastle, Saggart, Crumlin, and Esker ; and in the same direction an estate was given to the Irish chieftain MacGillamochlmog, who held sway over the territory of Cualaun when the Anglo-Normans arrived.

Ecclesiastical owners occupied in the Anglo-Norman settlement a no less important position than lay proprietors. The property which the Church possessed at the time of the invasion was left to its sacred uses ; and it was largely increased by grants from such Anglo-Normans as acquired lands. The Celtic monasteries disappeared ; but the possessions of those at Tallaght, Clondalkin, Finglas, Swords, and Lusk were given to augment the revenue of the See of Dublin, and the possessions of the others to various religious establishments. New monasteries and nunneries were founded. At Grace Dieu, in the northern portion of the county, there was a house for Canonesses of the Order of St. Augustine ; at Clontarf, a house of the Knights Templars ; at Kilmainham, a house of the Knights Hospitallers ; and near Lucan, at St. Catherine's, a house of the Congregation of St. Victor. But the largest ecclesiastical owners within the limits of the county were the great Dublin religious houses. A tract, extending from the

sea at Killiney to the Dublin mountains, as well as the lands of Glasnevin and Grangegorman to the north of the city, belonged to the Augustinian Priory of the Holy Trinity, afterwards merged in Christ Church Cathedral. The district now covered by Kingstown and the adjacent Monkstown was owned by the Cistercian Abbey of



FIG. 23.—Drimnagh Castle, Co. Dublin.

(Photo. by T. J. Westropp.)

St. Mary. Two estates—both known as Palmerstown—from one of which Queen Victoria's well known Prime Minister derived his title, belonged to the Hospital of St. John the Baptist, which had been founded by a pilgrim to the Holy Land. And Bald Doyle, near Howth, and

Drumcondra were owned by the Priory of All Hallows, whose site Trinity College now occupies.

By the Anglo-Normans the system of land tenure then existing in England was introduced. The estates were constituted into manors, and the lands were worked as in England by the owners, by free tenants, and by servile occupiers known as betaghs, who were drawn from the old inhabitants. A great number of the latter retreated, however, to the fastnesses of the Wicklow mountains, whence, after a time, they began to make raids on the property of the colonists, carrying off their cattle, and devastating and burning their lands. In the beginning of the fourteenth century, during the incursions of the Scots under Edward Bruce, the situation reached its climax. The betaghs employed in the low lands rose in rebellion, joined their brethren in the mountains, and regular warfare began between the colonists and the O'Byrnes and O'Tooles, as their neighbours were called. Every effort was made by the colonists to stem the advance of these tribes, and the southern border of the county became the battlefield. A garrison was stationed at Bray, where the river offered a natural obstacle, and a barrier, afterwards united to that which surrounded the English Pale, was carried from the river under the mountains round by Tallaght and Saggart towards the County Kildare. Its custody was committed to the Archbolds, the Harolds, and the Walshes, clans sprung from sturdy English and Welsh yeomen, who had been planted on the marches; and for a time good watch and ward were kept by these guardians, who became, however, subsequently as troublesome to English rulers as the tribes whom it was their duty to hold in check.

A brief survey of the principal buildings in the county of Dublin in the fourteenth century may help to illustrate its condition. Starting from the city along the sea to the south there was to be found at Monkstown a castle, the country adjunct of St. Mary's Abbey, and a little way off on the coast at Bullock a smaller fortified edifice protecting the fishery rights of the Abbey at that point (fig. 28). Dalkey next appeared. It was then a walled-in medieval town,

containing seven castles and a church of considerable size, and was a place of much importance as the port of Dublin, not only for passengers, but also for merchandise, and as a trading centre where weekly markets and frequent fairs were held. To the west, at Kill-of-the-Grange, lay the home-farm of the Priory of the Holy Trinity, with its manor-house and extensive farm buildings, of life on which an interesting picture is presented in the Account Roll of



FIG. 24.—Gateway of Castle of Archbishops of Dublin, Swords.
(Photo. by T. J. Westropp.)

the Priory, edited by the present Deputy-Keeper of the Records of Ireland.¹ Passing across the mountains, a large castle, the principal country residence of the Archbishop of Dublin, was to be found at Tallaght, and a small town with a handsome Gothic church in his manor of Clondalkin.

¹ "Account Roll of the Priory of the Holy Trinity, Dublin," edited by James Mills for the Royal Society of Antiquaries of Ireland: Dublin, 1891.

In the south-western corner of the county was the king's town of Newcastle, strongly fortified, and containing, like Dalkey, a number of castles, whose inhabitants have left a fine fourteenth-century window in the church as an indication of their wealth and taste; and near Dublin lay the king's smaller town of Crumlin, close to which flowed the ancient water-supply of the city.¹ Not far off from the latter place was Drimnagh (fig. 28), the seat of the Barnewalls, which survives as an inhabited dwelling to the twentieth century, and is the most typical specimen of the architecture of the English Pale to be seen near Dublin. Crossing to the north of the city by the Hospitallers' great priory at Kilmainham and by the Tyrells' fortress at Castleknock, which dominated the western part of the county, Swords was reached. Under the fostering care of the archbishops of Dublin, the ruins of whose castle may still be seen (fig. 24), this Celtic settlement had developed into a medieval town, rivalling Dalkey and Newcastle, and the parish had become so valuable as to be distinguished as the golden one. To the west of Swords lay at Dunsoghly a large castle, the seat of a branch of the Plunket family; to the north there were at Baldungan a fortress built by the Knights Templars, and at Balrothery, another owned by the Barnewalls; and to the east lay the castles of Malahide (fig. 25) and Howth, still to be traced in the present structures.

Under the Tudor sovereigns, owing to the increasing prosperity of the English Pale, additions were in many cases made to the existing castles, and the new dwellings which were erected, although still fortified buildings, were designed on more commodious and stately lines. Amongst the residences in the county at that period one of the first in importance was the castle of Merrion, which was then made their chief abode by the Earl of Pembroke's ancestors, the Fitzwilliams, who had been previously seated at Baggott-rath, now part of the Pembroke Township, and at Dundrum; but all trace of this castle has long disappeared, and its site

¹ See "The Water-Supply of Ancient Dublin," by Henry F. Berry, Assistant Deputy-Keeper of the Records of Ireland, *Journal Royal Society of Antiquaries of Ireland*, vol. xxi., p. 557.

on the Blackrock Road is now covered by the buildings of an asylum for the blind. Another castle which came into prominence in the sixteenth century as the home of Sir Thomas Luttrell, a judicial personage of much eminence, was that of Luttrellstown, which lies in a superb demesne on the banks of the Liffey near Lucan ; and at Rathfarnham Queen Elizabeth's Irish Chancellor, Archbishop Loftus, erected a mansion, which remains, according to the prediction of one of his contemporaries, a monument to the



FIG. 25.—Room over the Hall, Malahide Castle, Co. Dublin.
(From Bartlett's "Scenery of Ireland.")

greatness and grandeur of its builder. Other servants of the Crown who settled in the county found fitting homes in the houses vacated by the religious establishments on their dissolution, as, for instance, at Monkstown, Sir John Travers, one of the military rulers for whom the condition of Ireland then provided employment ; at St. Catherine's, Sir Nicholas White, a statesman whom Queen Elizabeth often summoned to her court ; and at Grace Dieu, Sir Patrick Barnewall, one of Henry the Eighth's most trusted law officers.

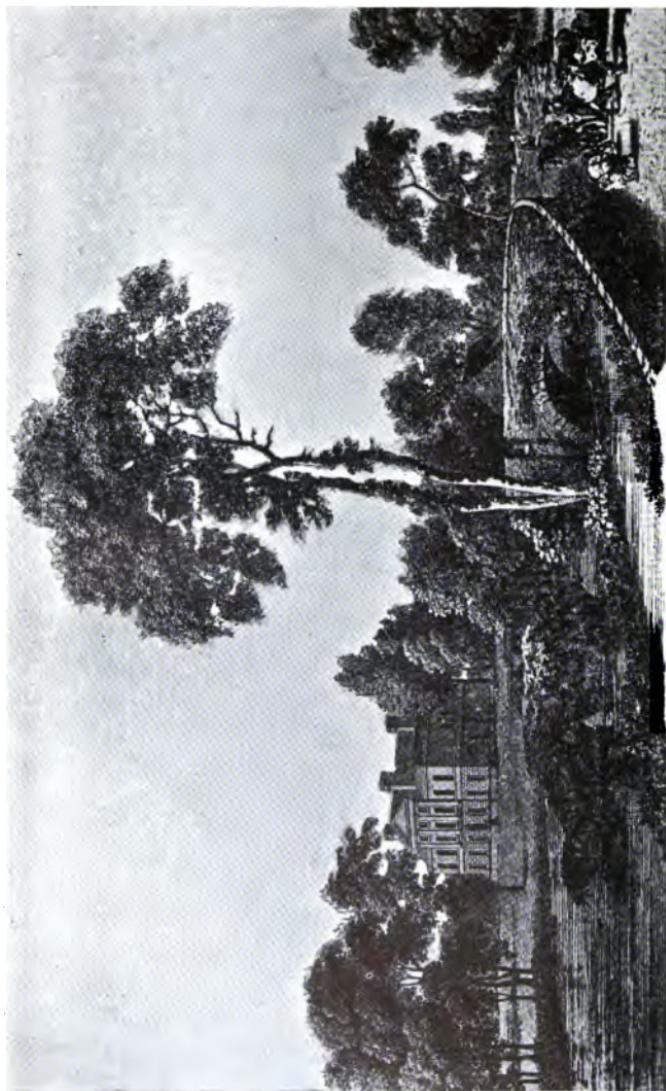
With the accession of the Stuarts an advance began towards dwellings of the modern kind ; and while the seventeenth century was still young, the viceroy was provided with a country retreat in a Jacobean house called the Phoenix, whose site, now occupied by the Magazine for the Dublin Garrison, formed the nucleus of Dublin's royal park. About the same time a distinguished soldier, Sir Henry Power, on whom the viscountcy of Valencia was first conferred, made use of brick in the construction of a fine residence, subsequently purchased for the viceroys, close by the Phoenix in the village of Chapelizod ; and his wife's family, the Buckleys, followed his example in the erection near Tallaght of a house called Old Bawn, which has only recently been dismantled.¹ During the Earl of Strafford's short but energetic rule in Ireland his friend Sir George Radcliffe was induced to expend what was, in those days, the enormous amount of £7000 on a mansion at Rathmines, the very existence of which is now forgotten ; and near Swords, where a house called Drinham still possesses many characteristics of that period, the Chief Baron occupied "a dainty, pleasant, high-built wood house" called Brazeel ; and the Speaker of the House of Commons "a gallant, pleasant seat," now known as Brackenstown.² As a result of the Rebellion and of the long war which succeeded, terminating in the county of Dublin in the battle between the forces of the King and the Parliament at Rathmines, many fortified buildings, which had survived from medieval times, disappeared. The Archbishop of Dublin's castle at Tallaght and the Fitzwilliams' castle at Baggotrath were amongst those demolished ; and Dalkey (which had sunk into insignificance, owing to the use of Ringsend as the port of Dublin), Newcastle, and Swords became villages such as they are to-day. After the Restoration, the construction of the Phoenix Park, under the direction of Charles the Second's

¹ A remarkable chimney-piece from this house, representing the building of the Walls of Jerusalem, may be seen in the National Museum, Dublin.

² See "Travels of Sir W. Brereton in Ireland, 1635," in "Illustrations of Irish History and Topography," by C. Litton Falkiner, p. 376.

PLATE XIII.

[To face page 239.



LUCAN HOUSE, CO. DUBLIN, IN 1785.
(From a plate in Milton's "Views of Ireland.")

illustrious viceroy, the Duke of Ormonde, was imitated by several of the leading proprietors in laying out great demesnes. The gardens of Howth Castle are believed to date from that period; and towards the close of the seventeenth century the Earl of Carysfort's ancestors, the Allens, began to empark a vast extent of country round Stillorgan, where they built a great mansion.

Shortly before the accession of George the First, the Fitzwilliams' castle at Merrion gave place to the house which their descendant, the Earl of Pembroke, now owns; and the broad avenues and noble plantings of Mount Merrion Park, which commands the most enchanting prospect of the bay of Dublin, were designed. Under the Hanoverian dynasty, building in the county advanced with rapid strides. On the south side of Dublin, at Tallaght, a palace was substituted for the medieval seat of the Archbishop of Dublin; at Rathfarnham, Archbishop Loftus' descendants, the Earls of Ely, transformed the castle into a modern house (fig. 26), whose walls Angelica Kauffman adorned, and to which a graceful classic gateway affords entrance; and at Cabinteely Earl Nugent erected a handsome residence. To the west at Lucan the husband of the far-famed Mrs. Vesey, the friend of Johnson, and a central figure in the blue-stocking circle, built a mansion in the Grecian style, which testifies to his architectural skill (Plate XIII). And on the north side of the city, Santry Court as the seat successively of the Barrys and the Domviles, Brackenstown as the seat of the Molesworths, Rush as the seat of the Echlinns, and Abbeyville as the seat of the influential John Beresford, were added to the great residences of the county.

To the Victorian age the rise of suburban Dublin is to be attributed, which had its beginning in the construction of Kingstown Harbour; but to country seats the reign of our late Queen saw no notable addition.



Fig. 26.—In Rathfarnham Castle, Co. Dublin.
(Photo. by T. Mason, Dublin.)

EARLY CHRISTIAN AND MEDIEVAL ANTIQUITIES OF COUNTIES DUBLIN AND WICKLOW.

BY T. J. WESTROPP, M.A., C.E., M.R.I.A.

The County of Dublin and its neighbourhood have the rare advantage of possessing a very typical series of remains, both ecclesiastical and residential. The early stone oratory and church, the later hermitage and vaulted church, collegiate, cathedral, and parish churches from the twelfth to the fifteenth century, the earthen ring-fort, the dry-stone ring-wall, enclosing a monastery, and the stone-castles, peel-towers and mansions of the Englishry from the thirteenth century downwards, are all represented. Those, however, who look for examples of ornate and beautiful architecture comparable to the churches of Great Britain and the Continent, will be much disappointed, for the poor and unsettled state of Ireland since the Norman invasion left neither time nor money for the construction of expensive and elaborate buildings. They will, however, be able to study not a few features of beauty, and many of interest, at Glendalough and Monasterboice (illustrating Irish art from the ninth to the eleventh century), with the Norman transitional work of Christchurch Cathedral and some beautiful Gothic details in it and the sister Cathedral of St. Patrick, which last lie outside the scope of this present section. The beautiful sense of proportion and effect that elsewhere in Ireland compensates so largely for the lack of magnificence is also wanting in this county, and must be looked for rather in the counties from Kilkenny through Tipperary and Limerick, and through the western coast-counties, with some pleasing examples in the Valley of the Boyne, and a few survivors in Ulster.

In our limited space we can best help our readers by giving a short list, classing the principal remains under their periods as far as possible.

The earliest-known type of stone church, the "boat-

shaped" oratory of dry-stone (of which specimens occur on the Atlantic coast), is not represented in this neighbourhood, nor are the early "bee-hive" cells found. Only one case of the early monastery in the ring-wall occurs; it is at Rathmichael. The stone double-vaulted oratory is found at Glendalough and at Kells in Meath; a much later equivalent remains at St. Doulough's (or St. Doolagh's). The early church, with projecting antæ, is more abundant, and there are excellent examples at Dalkey Island, Glendalough, and Dean's Grange. A richly decorated church of the later eleventh or early twelfth century stands at Glendalough; and there are traces of similar ornament, some of slightly earlier date, in certain of its other churches.

Round towers may be found within easy reach of Dublin (and, save the first, within a mile of a railway station), at Swords and Lusk (*via* Amiens Street Station), Clondalkin and Kildare (*via* Kingsbridge). A stump of a tower is at Rathmichael, the others being perfect, as at Clondalkin, or with only the tops modified. Within a short railway journey and drive are the towers at Glendalough (perfect), Monasterboice (*via* Amiens Street and Drogheda), and Donoughmore (car from Navan station, *via* Broadstone). Kells, in Meath, has a nearly perfect tower close to the station. At Monasterboice are three high crosses, two of rich design (a cast of the great cross put up by Abbot Muiredach, early in the tenth century, may be seen in the Museum, with casts of those at Kells). Kells possesses three, two of elaborate carving; plainer examples remain at Finglas, Tully, St. Doulough's, and Kilgobbin. The car excursion from Drogheda (see p. 266) can include in one day Monasterboice, the remains of the fine Cistercian Abbey at Mellifont, the tumuli and carved stones of Dowth and Newgrange, the mote, friary, and hermitage of Slane, the battlefield of the Boyne, and the gate, abbeys, and monuments at Drogheda. Trim, Bective, and Tara would require a day for each. There are small churches at Kilbarrack and Bray.

Of later churches of the Anglo-Norman period, the following are accessible:—St. Mary's Collegiate Church, Howth; St. Doulough's, with overcroft, attached cells, well-house, and cross; and the churches (so-called abbeys)

at Lusk, Swords, Malahide, and Baldungan. The last might be included with the others and St. Doulough's in a drive from Malahide.

There are but few good examples of "forts" (ring-mounds) near the city. Some occur on the flank of the Three-Rock Mountain near the Scalp, and one near Dunsoghley. The promontory fort of the Bailey of Howth is entirely defaced. Howth, Malahide, and Swords possess considerable remains of their fortified houses. Of peel-towers we have two at Dalkey, and others at Bullock, Monkstown, Kilgobbin, Howth (Corr Castle), and Puck's Castle, near Rathmichael; there is a very interesting tower and moated house at Drimnagh (see p. 288), not very far from the tramway station at Inchicore, and other peels occur farther away at Dunsoghley, Rob's Wall, near Malahide, and Portrane.

Very fine examples of principal Norman fortresses remain at Maynooth and Trim, which latter, with the ruins of the Yellow Steeple, the church, monastery, and hospital of Newtown, and St. Patrick's Parish Church, would supply abundant material for a day's excursion (see p. 279).

We now briefly describe the nearer remains rather by the lines of travel than by the periods which they represent.

DALKEY

is a small but ancient town, deriving its name from the neighbouring islet, the Dalkey of the Norse, the Delgh-inis of the Irish, the name meaning thorn island. Dalkey at one time possessed seven "castles"—a circumstance by no means incredible to anyone who has studied the Tudor and Stuart maps of Irish towns, showing rows of castellated houses in every street. The place was at one time a frequented port, and preferred by larger ships to the shallow river-mouth of Dublin. A place of wealthy merchants, we expect to find numerous relics of its past prosperity, but only two peel-houses remain; one is repaired, and forms part of the Town Hall, the other is an ivied ruin near the Roman Catholic church, which itself is on the site

of a third. There was a fourth, used as a forge till comparatively recent times, but now demolished. The existing towers are entirely devoid of ornament, and the details seem usually of the sixteenth century ; they have the usual vaulted rooms, "murder-hole" commanding the entrance, loop-holes, &c.

The church is dedicated to St. Begnat (locally "Begnet"), daughter of Colman, after whom the older church on the island is also named ; her date is uncertain. One of these churches figures as Kylbekenet in a charter of Luke, Archbishop of Dublin, in 1240. The north wall of the chancel, with its built-up window-slit (the semicircular head hollowed out of one block), is pre-Norman. The rest is of various periods, showing evidence of extensive repairs in the fourteenth and fifteenth centuries ; the lintelled west door is curious, and the bell-chamber is characteristic of the smaller churches of the English Pale. The whole has been much tampered with. An early stone, with a Celtic cross, stands near the south wall.

Near the harbour is a rock on which we remember a defaced description, reputed to be "Danish," but certainly not Runic. This was destroyed by the unfortunate insertion of a brass tablet, about 1880, commemorating the landing of certain viceroys, and the tablet was soon afterwards torn out and stolen.

Taking boat from the harbour, we reach the island and visit St. Begnet's Church, a small oblong oratory of very early date (fig. 22). It has projecting end-walls and antæ, and a fine door with heavy lintel and inclined jambs ; the east window was destroyed, and the gap built up when the church was used as a house by the workmen engaged in building the Martello tower about a century ago. Note the rude encircled cross cut on the rock-surface to the west of the church. Professor Joseph O'Reilly published some curious notes and theories in a paper on the fabric and orientation of this church.¹

¹ Proc. R. I. Acad. (1903).

KILLINEY—BALLYBRACK.

Here is another very early church, Cill inghine Lenin (the church of Lenin's daughters), which gives its name to



FIG. 27.—Killiney Church, Co. Dublin : West door.
(Photo. by T. Mason, Dublin.)

the place. It has a nave, chancel, and side-aisle. The first is entered by a west door like that of Dalkey, but with a cross on the soffit. Near it is a bullaun, or basin-stone,

The chancel-arch is semicircular, and, like all the features of the building, very plain. A lateral chapel or aisle has been added to the north side at a comparatively late period.¹

The so-called "Druid's Seat" and "Sun and Moon Stone" farther up the hill, in a grove, seem to be the much-altered remains of a dolmen and circle. An attempt was made to cut two millstones out of a side-block, originating the second name in the days when "ophite worship" and "druidism" dominated Irish archaeology.²

A small but very perfect dolmen stands in a field over half a mile away, near Ballybrack. Another dolmen of large size is found in the pretty valley of Glendruid, about two miles away. It and the old church of Tully, with two early high crosses and some curious carved slabs, are more easily reached by Carrickmines station, being within a mile distant from it. One of the Tully crosses, though plain, is of beautiful outline, and of the encircled type, in use in the tenth and eleventh centuries.

On the road from Dalkey to Dublin may be seen the very perfect peel-tower, the harbour, and portion of the wall of the little, early, walled "town of Bullock" (fig. 28). At Dean's Grange, about a mile behind Monkstown (which has the rude but fairly perfect remains of a castle with two late towers), we find a picturesque old graveyard. The church is an early building, with ante and a defaced lintel-lled west door. It has a late chancel; two small crosses set in massive bases are found, one in the graveyard, and one in the southern lane-way. A rock with several basins lies near the gate in this lane in a private garden.

HOWTH.

Proceeding from Dublin by train, we pass at Ballybough Bridge the site of the weirs of Clontarf. Here, on Good Friday, 1014, the Danes, after their defeat by the Irish under King Brian, were driven into the river and drowned in hundreds. The body of the king's grandson,

¹ Proc. Roy. I. Acad., xxv., p. 107, plan, p. 112.

² See W. C. Borlase, "Dolmens of Ireland," p. 393.

with its fingers tangled in the hair of a Dane, was found in the weirs. Passing Clontarf and Raheny, we see the picturesque ivied ruin of Kilbarrack, which is well seen from the tram; here the notorious Francis Higgins, "the Sham Squire," the betrayer of Lord Edward Fitzgerald, was buried. His tomb bore a most laudatory inscription, but was broken up by an indignant mob after the publication of the history of the betrayal.



FIG. 28.—Bullock Castle, Co. Dublin.
(Photo. by T. J. Westropp.)

Changing at Sutton, we descend the hill, passing Shelmartin (or Slievemartin), a barren peak, capped by the cairn alluded to by Sir Samuel Ferguson in his beautiful poem of "The Cromlech on Howth." Below it, nestling in a grove, is the tiny oratory of St. Fintan, embodying the features of an earlier church, and a supposed Runic inscription, of most doubtful character. At the

south-west corner of the Head, we see the Bailey Lighthouse, and what remains of the promontory-fort of the Great Bailey, alleged since 1838 to be the ancient Dun Griffin ; but the latter was probably a fort near Howth Harbour, since it faced Meath, and was near the sea-shore. Getting a series of charming views northward, including the islands of Lambay and Ireland's Eye, and a long reach of coast, with the great Mourne Mountains in the far distance, we run into the little fishing town of Howth.

Howth derives its name from the Norse word "hoved," a head ; the Irish name was Ben Edar ; the island of Edros is recorded in this place in Ptolemy's Atlas. It was captured on the landing of the Normans by Almeric de St. Laurence, whose title is still enjoyed by his lineal descendant, Lord Howth, after nearly seven centuries and a half.

The bold island opposite the harbour is Ireland's Eye, or Inis Mac Nessain. The former name, a mistranslation of the Irish "Inis Ereann," is really Eria's Island, a female name, confused with "Eriu" (or Ireland) by the Norse. It is interesting to note the group of other Norse names (Dalkey, Lambay, Fingal, Howth, Leixlip, Oxmantown) surviving round Dublin (*cf.* p. 280). A monastery on the island, founded by the three sons of Nessan, is marked by a church, once a very remarkable structure, with a round tower over the chancel ; it was then nearly levelled, and finally rebuilt by well-meaning local endeavour, which left it valueless and modern.

The more distant island of Lambay corresponds to the Rikina of Ptolemy, the native name being Reachra (Rechrainn), now only surviving in Portrane (the port of Rechrainn) opposite the island. It has a promontory-fort, and some trace of a castle. It is not impossible that Edros was really an island when Ptolemy wrote, for the broad, low neck at Sutton is part of a raised beach, and may have been overflowed by high water, at any rate.

The steep drift-banks abound in arctic shells, and these glacial beds are of considerable height ; the Martello tower is on one, on a site once occupied by an earthen fort. St. Mary's Collegiate Church stands on another.

Dr. R. Cochrane¹ points out that the church of Howth consists of an early portion, probably of the eleventh century, forming the porch and western end of the nave, a side chapel of about 1235, and a fifteenth-century addition, forming a chancel to the north, and a mortuary chapel of the St. Laurence family (Lords of Howth) to the south. A late three-chambered belfry was erected on the west gable, the bells of which are preserved in Howth Castle. The result is a two-aisled church, divided by an arcade of six opes, 95 feet long (fig. 29). The east gable of the mortuary chapel contains a window of rather pleasing design of the late fourteenth century, or the beginning of the following period, styles in Ireland being sometimes as much as forty or fifty years later than in England. In front lies an ornate and interesting altar-tomb, the sides having elaborate panels, with foliage common in Irish work of the later fifteenth century, and figures of the Crucifixion, saints, and angels, the instruments of the Passion, and the arms of the St. Laurences and other English families. The weather-worn recumbent figures of a knight and lady lie on the top slab ; the inscription is much defaced. The late fifteenth-century house, a college of canons, is well preserved, but crowded with poor small tenements. Dr. Robert Cochrane's papers on Howth should be consulted.²

The Castle of Howth is greatly modernised, save some ivied towers and a tablet of Christopher Lord Howth, an Elizabethan carving, with the arms of St. Laurence and Plunkett. The great sword of Sir Almeric, *circa* 1170, and the bells of St. Mary's Church are preserved; also a wooden carving of the abduction of the son and heir by the Amazonian, Grania Uaille, or Grace O'Malley, who was offended at finding the castle gates closed at dinner-time in the reign of Elizabeth.³ The family long commemorated the event by keeping the hall-door open. There is also a

¹ Journ. Roy. Soc. Ant. Ireland, vol. xxvi., p. 1.

² Journ. Roy. Soc. Antiq. Ireland, vol. xxv., and paper on "The Howth Monument," by Lord Walter Fitz Gerald, *ibid.*, vol. xxxvii.

³ The tradition is unreliable; but a similar event occurred at an earlier period. The subject of the representation is also open to doubt.



FIG. 29.—St. Mary's Collegiate Church, Howth, Co. Dublin.
(Photo. by T. F. Geoghegan, Dublin.)

very ancient tree, which local legend connects with the existence of the family, a branch being said to fall on the death of any man of the St. Laurences.

MALAHIDE.

This place lies about eight miles to the north of Dublin. By taking a car, a pleasant excursion may be made to St. Doulough's Church, Lusk, Swords, and, perhaps, Baldungan, though the last is best reached from Skerries, being nine miles and upward from Malahide. These places all lie in the old Norse territory of Fingal.

Malahide, a quiet little watering-place on a creek, the mouth of which is defended by a very small peel-tower, called Rob's Wall, is chiefly remarkable for its castle and church. The former is still occupied by the descendant of its original owners, the ancient Norman house of Talbot de Malahide. Though greatly modernised, it retains several round towers and other relics of the older building, a fine panelled room over the porch, and a picturesque dining-hall (see fig. 25).

Richard Talbot, the founder, obtained these lands by a grant from Henry II about 1174. The church, or abbey, lies close to the castle. It consists of a nave and chancel, with a two-storied residence for the priest to the south-east. The remains are in fair preservation, though, as occurs too often, greatly overgrown. The features are clumsy, especially the east window, which is a very interesting example of perpendicular tracery, as rendered by the masons of the English Pale. In the nave is a fine altartomb, very like that at Howth and others of the fifteenth century; it is surmounted by the effigy of a lady wearing a long pleated dress and a horned cap. It commemorates Maud Plunkett, "maid, wife, and widow in one day," for her first husband, Hussey, Lord of Galtrim, was killed on her marriage-morning, when engaged in repelling a band of plunderers. She afterwards married Lord Talbot.

St. Doulough's Church.—This is a unique edifice, dating mainly from the later thirteenth century, but having affinities in its vaulted church and overcroft to the early

Irish stone-roofed churches of Wicklow, Louth, Meath, and Clare. The name is very suggestive of the Irish word Damhliag (Duleek, stone church), but is supposed to be taken from an obscure seventh-century monk, Dulech, or, in the opinion of others, from the Norse Olaf. The church is vaulted, with an overcroft ; the west end is occupied by the cell of a recluse, containing a plain altar-tomb, the reputed bed of St. Doulough. There are seven apartments, three stone staircases, and a low, battlemented tower ; the approximate dates are about 1280, 1406, and 1506 (Plate XIV).

In a field to the north is the well-house, a quaint, octagonal structure. The sill of the well is cut out of a single stone ; the older broken ring is seen underneath ; the vaulted dome was once painted with figures, but little trace remains. The building has four upper lights and a lintelled door ; it stands in a sunken area. By the roadside, and at the entrance to the churchyard, is a primitive-looking cross, the lower limb expanding, and the arms square—a form found from Bosnia to the extreme west of Ireland. The tower seen on a ridge between this church and Malahide is the ruined windmill of Feltrim ; the name means “ridge of the wolves.”

SWORDS.

Our space barely allows us to call attention to this most interesting place, the ancient Sord Choluimbcille, an important Columban foundation, and in later times (like Tallagh) one of the country residences of the archbishops of Dublin. It is pleasantly situated in an undulating wooded country, about three miles from Malahide, at the head of the creek. The massive plain tower, with hideous modern battlements, alone remains from the fabric of the medieval abbey, of which extensive ruins stood even in 1790. They were removed to build a pretentious modern church in the Gothic of the early nineteenth century. The Irish monastery, strange to say, has also left no trace but its belfry, a round tower, the upper story, and conical cap evidently rebuilt (fig. 80). It is 75 feet high, and about 55 feet in



ST. DOULOUGH'S CHURCH, CO. DUBLIN, FROM THE SOUTH.





circumference, with its ancient lintelled door, which, by the raising of the ground, is (like that of Lusk, and unlike most examples) easily accessible. In the valley, beside the stream, and adjoining the village, is the Archbishop's



FIG. 30.—Round Tower and Abbey Belfry, Swords.
(Photo. by T. J. Westropp.)

Castle. The outer walls, with their various buildings and towers, including the great gateway, the chapel, and residence, are in fair preservation. It now only defends a kitchen-garden. (For view of gate, see fig. 24.)

LUSK.

The monastery of Lusk (*lusca*, a cave or artificial souterrain) was founded at the end of the fifth century by Macculin. The holy well, with a stone "marked by his knees," still bears his name ; it is now enclosed in a modern garden. The history of the abbey actually begins with Petranus, a Breton, bishop and abbot about 616 ; he is also patron of Llanpadarn in Wales. It flourished till its destruction by the Danes in the ninth century, struggling to survive, but again and again ravaged by the foreigners. It was probably, like all ancient monasteries in Ireland, a village of wooden-wicker and earthen huts, crowded round one or more churches, and, in this case, round a fine round tower, its only existing relic. When the district was occupied by the Anglo-Normans, the church was rebuilt and dedicated to the Virgin. In 1179 a papal bull assigned it to St. Laurence O'Toole, Archbishop of Dublin, whose successors held the lands till the disestablishment of the Church of Ireland in 1870. The Normans expelled the Irish monks the year after the bull was granted. The round tower was fortunately preserved and embedded in the medieval belfry by the later builders (fig. 81). Their intention was probably to make it a north-east turret, as they built round turrets to the three other angles, but by some oversight the corner of the new belfry overlapped it. The old belfry is about 95 feet high, and 53 feet in diameter. It only lacks its ancient conical cap, and none of its features are modified ; they include the four small windows facing the cardinal points in the top story and other little lights ; the door is plain, massive, and lintelled, facing the east. (For section and sketch of door, see fig. 82, Nos. 1 and 2.) The later belfry is a castle-like structure, with (as already said) three corner-turrets, one with a spiral stair. The top commands a fine view. In the interior should be examined the Bermingham and Barnewall tombs, removed for shelter from the site of the older chancel. That of Sir Christopher Barnewall of Turvey, 1589, has effigies of that knight and his wife, with elaborately carved embroidered clothing. The names of nineteen of their children are carved on it. The second tomb, of James Bermingham, displays a knight in armour,

in lower relief, with a hawk holding a bird; the date is 1627, but by a break appears to be 1527; the style is probably copied from some older tomb. The ancient



FIG. 31.—Round Tower and Belfry, Lusk, Co. Dublin.
(Photo. by T. J. Westropp.)

church, with two aisles, divided by an arcade of seven Gothic arches, was swept away after 1889, and a neat edifice built on part of the site. Among its monuments was once a supposed idol, a hideous face, with legs issuing from it, probably one of the curious and usually indecent grotesques (not confined to Ireland) called "Sheela-na-gigs" from a well-known figure in County Cork. The Lusk "idol" was buried by a too scrupulous rector as a relic of heathenry.

ROUND TOWERS OF CLONDALKIN, &c.

We may here close the subject of the Round Towers in Co. Dublin. That at Clondalkin is a perfect but rather poor structure, 89 feet high and 47 feet round. (For section and view of doorway, see fig. 82, Nos. 3 and 4.) At Rathmichael is a stump 8 feet high and 52 feet round. It stands beside a ruined church, part of the nave wall early, the chancel late. In the graveyard are several curious early tombstones, with scribings and a holed stone. Outside the modern boundary are considerable remains of the ancient ring-wall of earth and dry stones, and the piers of the gateway, the well, basin-stone, &c. The round tower of St. Michael le Pole stood in the city, in a court off Ship-street, behind the Castle. It was much injured by storms and decay, but was repaired judiciously by Dean Swift about 1788. A severe storm in 1775 so shook it that it began to lean over in 1778, though otherwise perfect, even to its conical cap; the authorities and architects, after trying to preserve it, were compelled by signs of collapse to level it. Beranger's striking view of it is well known; it was taken in 1778.

GLENDALOUGH.

This picturesque glen and group of ruins, reached through a beautiful stretch of country, lies in the heart of the Wicklow mountains. The remains have been described at some length in the Journal of the Royal Society of Antiquaries for Ireland in 1895, to which we refer for details.

Glendalough, the valley of the two lakes, lies over nine

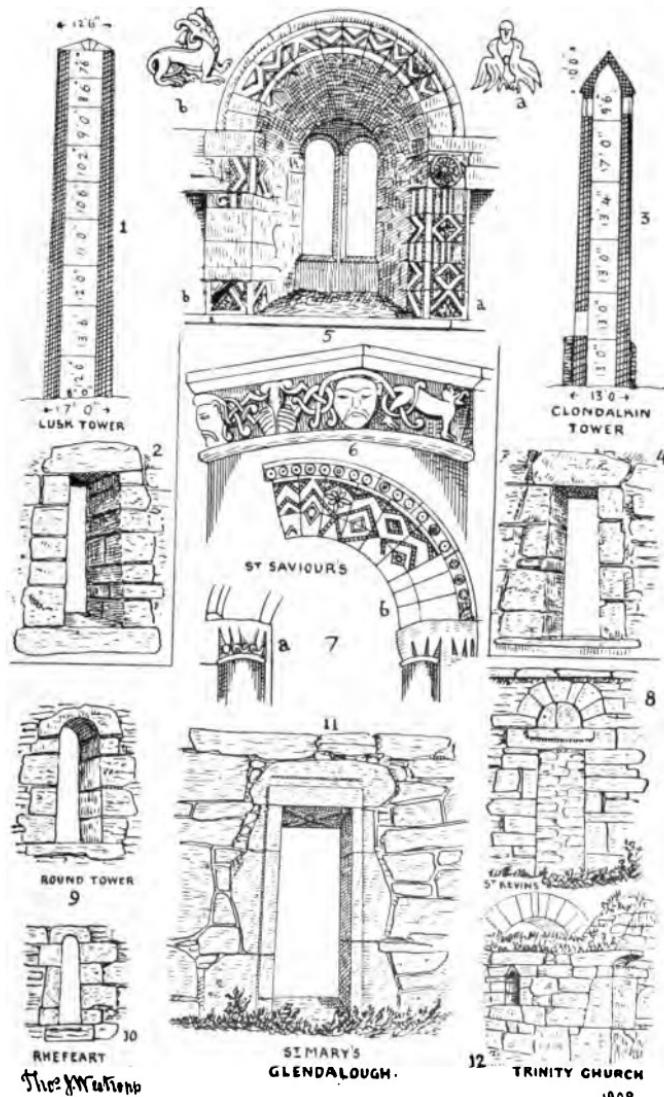


FIG. 32.—Details of Early Irish Buildings.
(References in text)

miles from Rathdrum station in one of the most beautiful nooks of Wicklow. We drive through picturesque woods and hills, with charming views over the valleys, and finally enter on a long glen, overshadowed by heathery or wooded ridges, and brightened by more than one rapid mountain stream. As the view opens up, we see the lofty round tower, the similar, but smaller, belfry of St. Kevin's Kitchen, and the gables of the ruined cathedral, with the shimmer of the lakes beyond, making, with the dark hills behind, a most impressive picture.

The monastery was founded at the end of the sixth century by St. Kevin, or Coemhgen (fair-born), a scion of the then ruling clan in County Wicklow. Two brothers and two sisters of his have also won places among the saints of Ireland. One brother founded the lonely little church half buried in the sandhills of the isle of Inishere, in Galway Bay, and is a powerful storm-queller in the belief of the fishermen. St. Kevin was educated by his uncle Eugene, Bishop of Ardstraw, by whom he was ordained priest, and, deserting the world, adopted the life of an anchorite, dwelling in a hollow tree, and, later on, in a small artificial cave, overhanging the upper lake, in the "desert of Glendalough." Crowds were attracted by his austerity and piety; a monastery sprang up, with several churches, and at his death (June 3rd, 618) its future was well assured. The city prospered for many generations, but by the time of the Norman invasion it had become deserted, and the valley was a "cave of robbers." St. Laurence O'Toole, Archbishop and patron of Dublin, endeavoured to revive it at the end of the twelfth century. He in some degree succeeded, and its "chorepiscopi," or rural bishops, are named in the following century. At last, though united to the See of Dublin, in the arrangement recognized by the English Government, it obtained bishops of its own, recognized by the Pope and the hill-tribes; but these never troubled to get formal grants of the temporalities, over which, indeed, the feeble English Government at Dublin had no control. Dublin was long kept in fear of the ferocious O'Byrnes and O'Tooles, who "wasted all the plain" to the Liffey, and laid ambuscades for the citizens in the present suburbs of

the city.¹ The bishops' names occur down to the sixteenth century; but we have at present no evidence to show when the series closed, and the cathedral and churches fell into ruin.

The two churches lying nearest to the mouth of the glen are the "Trinity" or "Ivy Church" beside the road, and St. Saviour's monastery across the river, reached by a path along the flank of Lugduff, from the bridge near "St. Kevin's Kitchen."

Trinity Church should be first visited; it is an early building, probably dating, at latest, from the early tenth century. It has a nave, chancel, and west room. The latter was an afterthought, though an early one. A tall, circular belfry rose upon its square enclosure, but, save the under corbeling of the vault, nothing of the tower remains. Several views are preserved, which show it as thickly ivied; it appears to have fallen towards the end of the eighteenth century. The church is still entered by a south door, the old west door with lintel and inclined jambs now leading into the west room. The choir arch is a massive, plain, but finely-built structure. The east chancel window is round-headed, both in ope and splay-arch, with a curious hood-slab; the southern is of that very early type (frequently found in the round towers), the head of which is formed of two slabs leaning together. Note the "Handle Stones" projecting from the east corners of the outer angles (see fig. 82, No. 12).

Passing an old slate block, engraved with a cross, we find near the hotel the ancient gatehouse of the monastery. It was a low tower, resting on two well-built, round-headed arches; the tower and one arch fell, but the latter was rebuilt from the original blocks. A rudely paved road leads inwards and upwards from this building.

The *Cathedral* was once a plain, oblong church, with projecting anteæ to each face; fragments of the pillars of some earlier church are embedded in its walls. In later days the chancel and vestry were added. The elaborate

¹ The "three castles on fire" in the City arms refer to an act of English retaliation against the hill tribes (*cf.* pp. 234 and 284).

chancel window, illustrated by Ledwich (1780) and Petrie, is somewhat mythical, as the inner arch alone, with its simple, shallow chevrons, was standing at the earlier date, when the drawings were done, and the arrangement in the restored window (as drawn) is unlike any other of the period as known to have existed in Ireland. By the time of Petrie the arch had fallen, and only a rugged gap remained, much as we saw



FIG. 33.—St. Kevin's Church, Glendalough, Co. Wicklow.
(Photo. by T. J. Westropp.)

it in 1876, when it was repaired in the restorations made by the Board of Public Works. Some early tombstones, with defaced Irish inscriptions, and other slabs (highly ornamented, but of later date), lie in the chancel. The latter division measures 25 feet by 21 feet 10 inches; the nave 48½ feet by 30 feet. The chancel is an afterthought. In the nave we

note the broken piers of the once elaborate north door and the west door, an advance on the lintelled type in having a semicircular relieving arch above its lintel. The lower part of the walls show larger and older masonry of the original structure. The church was dedicated to SS. Peter and Paul after the coming of the English.

St. Kevin's Cross is a granite monolith, a Latin cross, with only very small segments of a circle at the junction of the arms. It is 11 feet high; the shaft has a spade-like projection at the base.

Regles an da Sinchell (the church of the two Sinchells) was burned, with the neighbouring Cro Chiarain, in 1168; the foundations of its nave and wall have been excavated, but Cro Chiarain has not yet been unearthed; it lies near Kevin's Kitchen.

Cro Chaeimghin, or "St. Kevin's Kitchen" (fig. 83), a most perfect specimen of the two-vaulted oratory with a steep stone roof, is an oblong church, 28 feet by 15 feet, with a barrel vault, through a circular ope, by which access can be had to the overcroft. The west door is lintelled with a relieving arch, closed by two stone slabs, and the cornice below the roof is continued across the west face (fig. 82, No. 8). The round-headed original east window is seen above the later chancel-arch. Soon after its erection several additions were made. A round-headed arch was cut in the east end, a chancel built with a vaulted sacristy, or "Erdamh," to the north, and a circular belfry (a miniature round tower with upper lights facing the cardinal points) built on the west end of the roof. The chancel has been removed, but the belfry and sacristy are in admirable preservation. A small high cross, carved slabs and fragments, querns and mortars, have been gathered into this church, which forms the museum of the explorations made in 1876.

The *Priest's House* lies to the north-west. It had remarkable capitals, with human heads at the angles, the long moustaches held by whale-like monsters; only parts now remain. These support an unusual arched recess in the outer east face. Part of another curious carving of St. Kevin, between a bishop and a bell-ringer, is of early

date, and set over the south door. The old dry-stone cashel (or enclosure) of this church should be noted.

The *Round Tower* (fig. 34), the most prominent feature

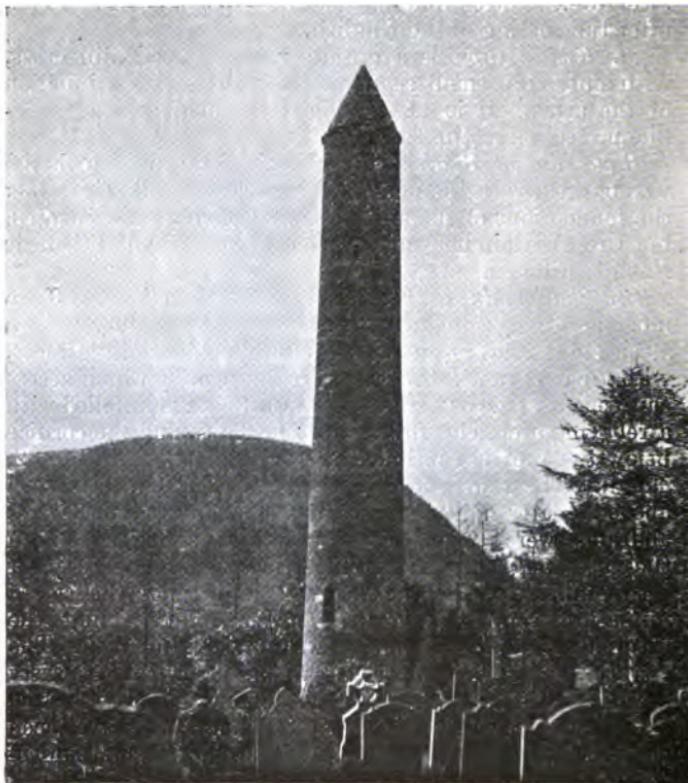


FIG. 34.—Round Tower, Glendalough, Co. Wicklow.

(Photo. by T. J. Westropp.)

of the ruins, stands about 50 yards from the Cathedral. It is 110 feet high and 52 feet round, coarsely built of mica-slate and granite. It has a slight base, a round-headed

door (not arched, but the head formed of one stone) standing 10 feet above the ground, and the usual slit-windows (fig. 82, No. 9). The cap was rebuilt from the original stones found inside the tower in 1876.

Crossing the stream, we see a rock, with a basin called the "Deer Stone," after the legend of a doe supplying St. Kevin with milk. If we turn eastward down the valley, we find in the low fields the most elaborate of the churches, its modern name being *St. Saviour's*. It is surrounded by a fir grove, and consists of a chancel, 14 feet by 11½ feet, and once vaulted, and a nave, 45 feet by 19 feet. The chancel arch, of very rich Hiberno-Romanesque work, from about 1080 to 1120, rests on clustered columns; the arch is rich with dog-tooth, chevrons, and beading. The east window-jambs are decorated by those curious carvings of ravens picking a skull, dragons, &c., so often illustrated in works on Irish antiquities (fig. 32, Nos. 5-7). The residence is almost featureless, lying to the north of the nave; steps lead from it up the east gable to the broken vault of the chancel.

St. Mary's Church, or Kill Iffen, lies to the west of the great cemetery. It was named "Cil Ifn" after a certain Aiffen (commemorated on June 3rd), whose history is unknown. He is named in the Life of St. Kevin and the Martyrology of Donegal, and lived early in the seventh century. The former work tells us how St. Kevin, warned by a vision, directed a church to be made to the east of the lesser lake to be the "place of his resurrection." Dima and his sons, the owners, gave him the site, asking where it should be. St. Kevin replied that it should be built round a shepherd's grave, a spot covered with thorns. He was laid there when he died. There was a beautiful strain of tenderness in St. Kevin, shown in the older "Lives." He loved and was loved by birds and beasts. Later legend "improved" on this theme by telling how the blackbird laid her eggs on his hand, outstretched in prayer, and he let her hatch them there. This gives him his distinctive symbol in Art. The very late legends, full of vulgar pleasantries or bad taste, include his pushing the too loving Kathleen into the lake and drowning her; in the older

legends he only gives her prototype a well-deserved whipping. The church has a nave and chancel, 32 feet by 20½ feet and 21½ feet by 19½ feet. The former is the oldest, having a very fine lintelled door, with inclined jambs, a raised band round it, and a saltier with rings at the ends cut on the soffit (fig. 82, No. 11). Before this door Sir Walter Scott once amazed his companions by sitting for some time wrapped in contemplation. The north door is unusual, narrowing from the top downwards. There is a cornice across the west face, level with the side-walls. The choir-arch is broken, several ancient tombs lie in the chancel, and the east window is round-headed, and has a "Wall of Troy pattern" on its outer hood, probably belonging to the late twelfth century.

Between the lakes were two burial-grounds. One remains, a primitive-looking ring-wall, with small cairns and a cross. Another larger, but broken, cross stands to the north side of the lower lake and beside the road.

Rhefeart Church.—To the south of the neck between the lakes we find an early church founded by St. Kevin; round it is the cemetery of the Wicklow chiefs. It is beautifully situated, though the new plantations are rapidly shutting out the view of the lake, which once made a delightful background to the ruin and the mossy green graveyard, with its crowd of slabs and ancient Celtic and Latin crosses.

The church has a nave and a chancel, 29 feet by 17½ feet and 14 feet by 8½ feet, and has been extensively rebuilt since I first saw it in 1876. The chancel arch was rebuilt from the fallen blocks, and is plain and semicircular; the windows are round-headed (see east window, fig. 82, No. 10). Those of the south wall have each the arch of the splay as well as the light scooped out of a single stone. The chancel has projecting handle-stones at the angles. The west door is also a fine specimen of the lintelled type, with inclined jambs, like that at Kill Iffen. The alleged tomb of King O'Toole has been broken up and sold piecemeal by the unscrupulous and ignorant "guides" to more ignorant tourists as "bits of the tomb of a real old ancient Irish king." The trade continued till very

recent times, for stones were as abundant as the tourists' credulity. The inscription which led to this miserable vandalism was alleged to have run : "Jesus Christ mile deach feuch corp Re mac m thuill"; it really read : "Or do Corpre mac Cathail," a person who died in 1018. Unfortunately the inscription, as misread, fell in with the vulgar modern legends of the "guides."

The place was the "Prioratus de Rupe," "Conventus de Deserto," and "Disert Coemghin" of the ancient records, traditionally the hermitage of St. Kevin. It was given to the Augustinians in 1264.

St. Kevin's Bed.—Taking boat on the upper lake (the only safe alternative to a most dangerous and rugged path), we come below a narrow square cell, hewn, or perhaps enlarged, from a natural cave, in the precipitous rock. It can be entered from overhead. It is said to have been "Kevin's bed," where he kept Lent. Archbishop Laurence O'Toole used to do the same in veneration of his saintly predecessor.

Teampull na Skellig.—The church of the rock, latest and most western of the ruins, stands on a steep slope of fallen rocks. It is an irregular oblong oratory, about $25\frac{1}{2}$ feet by $11\frac{1}{2}$ feet. The east window, like that of St. Saviour's, has two lights under one splay, cut in this ease from a single stone. Three old slate crosses stand in the cemetery; one has an arrangement of squares and concentric circles. The view from the hillside above it down the glen is very beautiful: the ruin at our feet, the dark lake, the steep crags, with their oaks and hollies, and, far down the valley, eastward, the lofty round tower rising over the clustered trees, with the brown heathery hills behind.

ANTIQUITIES OF THE BOYNE VALLEY.

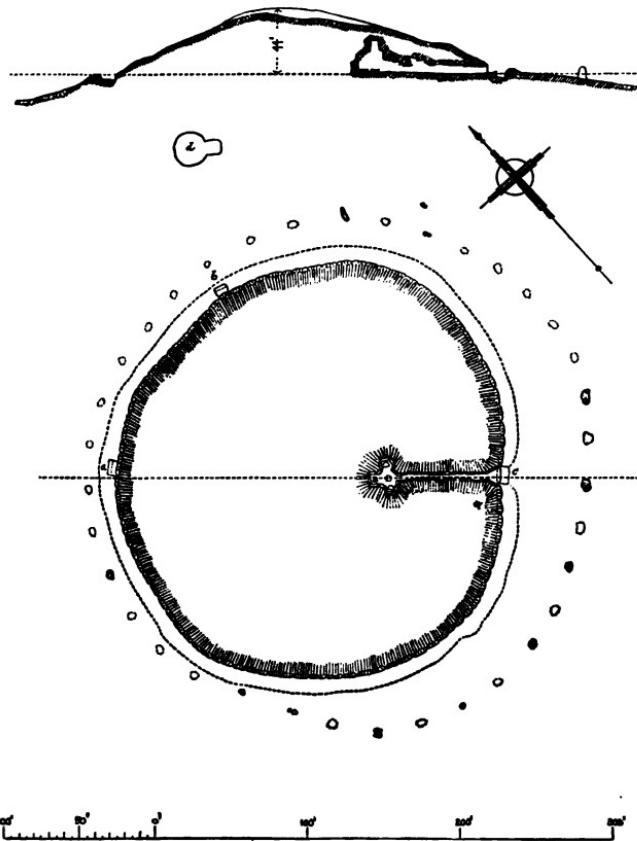
BY JOHN COOKE, M.A., M.R.I.A.

The Boyne Valley is one of the most interesting tracts of country in Ireland. In it are some of the finest remains of pagan Ireland now existing; it was the scene of the labours of Ireland's greatest saint, and is remarkable for the number of its churches, abbeys, crosses, round towers, and other ecclesiastical remains. As the border of the Pale it bristled with Anglo-Norman castles, and its banks saw the most decisive battle in Irish history, and hardly less so in English, since it proved the downfall of a British dynasty.

DROGHEDA.

Drogheda—Irish, *Droichead-atha*, “the Bridge of the Ford”—dates from an early period, the broad estuary of the Boyne being one of the most important inlets on the eastern seaboard of Ireland. Turgesius, the Dane, made it a strong Norse settlement, and a centre from which to raid the rich midland country; and here, later on, the Anglo-Normans erected a castle on each side of the river and a bridge across the Boyne. It grew in importance in the middle ages as a great stronghold of the Pale, and successive Parliaments were held in Drogheda, notably Poynings' (1494), whose enactment, that no law could be passed by the Irish Parliament which was not approved of by the English Privy Council, was the cause of much subsequent dissension. Drogheda figured in the wars of the seventeenth century; and in 1649 Cromwell took it by storm and put the garrison to the sword. Behind the workhouse stood the mound from which he made his attack on the town, “made the breach assaultable, and, by the help of God, stormed it.” The town was held by Lord Magennis of Iveagh for James II in 1690, but it surrendered on the day after the Battle of the Boyne.

Drogheda was a walled city, and was strengthened with many towers and entered by many gates. Of the latter St. Lawrence's is the only gate remaining, one of the



PLAN AND SECTION OF TUMULUS AT NEWGRANGE.

(From Trans. R.I.A., vol. xxx.)



most interesting examples now standing in Ireland. The ruins of the Abbey of St. Mary are few—a central tower with a pointed arch is all that has survived the ravages of time and the terrible battering of Cromwell's guns. The abbey belonged to the Augustinians, and was founded in the reign of Edward I on the site of an older church, said to have been established by St. Patrick. The Magdalen Steeple, a lofty tower of two stories, springing from a fine pointed arch, and a conspicuous object on the north side of the town, is all that remains of the Dominican Abbey which was founded in 1224 by Lucas de Netterville, Archbishop of Armagh. St. Peter's Church, with its massive tower and lofty spire, has been erected to the memory of Oliver Plunkett, Roman Catholic Archbishop, who was a victim in the days of the "Popish Plot," and was hanged at Tyburn. His skull is preserved in the Dominican Convent in the town.

Drogheda is well situated on both banks of the Boyne, four miles from the sea; and at the harbour end a fine railway viaduct, designed by Sir John McNeill, crosses the river at a height of 90 feet above high water. It consists of twelve arches of 60 feet span on the south side, three similar arches on the north, and these are connected by a lattice-bridge 550 feet in length. The harbour has been improved at different times, and there is a good cross-Channel trade, chiefly in provisions, with Liverpool. Drogheda has flour and other mills, breweries, tanneries, salt-works, and soap-works.

Within a drive of three miles by the river is the site of the Battle of the Boyne. The spot where William III was wounded is marked by an obelisk (1786), and the small village of Oldbridge existed at that time on the south bank of the river.

NEWGRANGE.

The great chambered Tumuli,¹ situated in the valley of the Boyne towards Slane, are amongst the most remarkable monuments of pre-Christian ages in western Europe.

¹ These tumuli have been described and illustrated by G. Coffey, *Transactions Royal Irish Academy*, vol. xxx., 1892, p. 1.

These have been identified with the Brugh na Boinne of the manuscripts and tradition. The largest is Newgrange, about four miles from the battlefield, which has been open since its entrance was first discovered in 1699 by Edward Lhwyd, Keeper of the Ashmolean Museum, Oxford. Particulars of his remarkable discovery, with a description of the chambers, were published in the Transactions of the Royal Society. Newgrange stands on rising ground, and the trees and bushes growing on it give the mound the appearance of an ordinary hill. It has suffered much in the course of time, as the inhabitants had for ages been using it as a quarry from which to draw material for road-making and building purposes. A great circle of standing stones seems originally to have surrounded this tumulus, and of these twelve now remain, four of which vary from 6 to 8 feet high and 15 to 20 feet in circumference; these stand 80 feet apart, and if the circle were complete, the original number would be thirty-five. Within this circle a rampart or ditch of loose stones encloses the base of the mound, well defined everywhere except on the east side. The tumulus consists of a mass of loose stones about an acre in extent and covered with grass; and if the ground to the circle of standing stones be included, it would extend to two acres. The base of the tumulus is retained by a belt of large stones from 8 to 10 feet in length, on which a dry wall has been raised to a height of 5 to 6 feet. The entrance to the passage is to the south, and across it lies an immense block covered with a series of spirals, a cast of which is in the National Museum (Plate XVI); two others have been discovered in the circle of great stones enclosing the mound, and a carved stone is seen immediately above the entrance. The passage runs nearly north and south, and measures 68 feet in length; it is 4 feet 9 inches high at the entrance, increasing to 6 feet at a distance of 26 feet from the opening, but decreasing again to the first height at 48 feet, when it rises again rapidly until it joins the chamber-roof. It is 8 feet 5 inches broad at the base, and some 8 inches less at the roof; and these dimensions are nearly average throughout its length, except at one



ENTRANCE TO TUMULUS, NEWGRANGE.

(From Trans. R. I. Acad. vol. xxx.)





or two spots where the supporting stones have been forced from their position. The passage is formed of great upright blocks of stone, measuring from 5 to 8 feet high, and numbering twenty-two on one side and twenty-one on the other; and across these slabs are placed, forming the roof. The plan of the chambers is cruciform,



FIG. 35.—Carving on stone, west recess, Newgrange.

three recesses opening out of the central chamber. This is formed by successive layers of stones, each course projecting slightly over the one beneath, and gradually closing, in beehive fashion, until a single flag is sufficient to form the last course and complete the roof. The height of the chamber is 19½ feet; the east recess is 7 feet 9 inches in depth; the north, 7 feet 6 inches, and the west, 8 feet 4 inches. On the floor of each is a large stone, hollowed out into the shape of a shallow basin; a finer basin, with two peculiar

cup-like depressions, stands in the centre of the great chamber ; it originally stood in the east recess, but was removed here in recent times. The stone is granite, and the suggested origin is either the mountains near Newry, or those of Wicklow. (Plate XVII.)

The basins were very probably used for the reception of the cremated remains of the dead, with an inverted urn placed over them. Burnt bones have been found in a kistvaen on the west side of the slope of Newgrange. Similar finds have been made at Dowth and Loughcrew, in the latter case in connexion with fragments of urns, which goes far to establish the theory that these basins were connected with urn-burial.

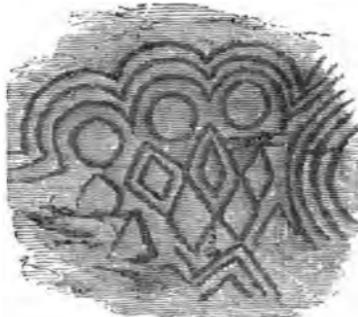


FIG. 36.—Carving on stone, east recess, Newgrange.

The sides of the recesses are formed by large blocks of stone, and several of those in the passage and here are covered with carving of great variety and interest. The cuttings on the roof of the east recess exhibit much ingenuity and care, and a stone at the entrance of the west recess has a carving of what appears to represent a branch of fern (fig. 35). Most of the cuttings on these stones must have been made before the passage and chambers were built, especially those in the east recess, for in their present position they could not be worked upon with any instrument (fig. 36). Casts of many of the worked stones are in the National Museum of Science and Art. With



RECESSES IN TUMULUS, NEWORANGE, SHOWING BASINS.

(From Trans. R. I. Acad., vol. xxx.)





the exception of the basins, all the stones used in the construction of the passage and chambers are local.

According to the "Annals of the Four Masters" and the "Annals of Ulster," the cave of Achad-Aldai, which is supposed to be Newgrange, was plundered by the Danes in 861. As it was the custom of the Norsemen to bury their chiefs and warriors, with their arms, ornaments, and other valuables, in mounds and cairns, the Danish invaders would, no doubt, expect to find treasures in the cemetery of Newgrange, and would consequently explore it with that hope.

DOWTH.

Over a mile to the north-east is the great tumulus of Dowth, which is about the same size as Newgrange, and,



FIG. 37.—Passage into tumulus of Dowth.

like it, was plundered by the Danes at the same time. It is 280 feet in diameter, and 47 feet high; it is surrounded by a belt of stones, but, unlike Newgrange, has no retaining wall. It was explored by a committee of the Royal Irish

Academy in 1847, of whose survey no account whatever has been preserved. An opening then existed on the west side, and this was followed, and the central chamber and recesses were revealed. The cutting was continued to the centre of the mound without any further discovery. About fifty feet to the south, however, another set of chambers was found, and a number of small sling-stones, glass and amber beads, pieces of jet, bone and copper pins, iron knives, human and other bones, were discovered during the exploration. The entrance has been protected by new work, so that its original form cannot now be seen.



FIG. 38.—Carvings on stones at Dowth.

The passage is 27 feet long, and built with stones set upright, some of which measure 10 to 12 feet in height. Immense flags form the roof, which are not corbelled as at Newgrange. Sill-stones are placed across the passage, and at the entrance of the central chamber and two of the recesses; these are not found at Newgrange. The general plan is cruciform, the central chamber being 11 feet high, and 9 feet in diameter; on the floor is a large shallow basin, which has been broken to pieces, but is now put together; the recesses are smaller than at Newgrange, and they contain no basins. A great stone 9 feet high and

8 feet broad, between the north and east recess, is remarkable for its peculiar and varied carving; other stones in this chamber are also carved, but all are of a ruder character than those at Newgrange. The south recess leads into a double set of chambers, one extending to the west and the other to the south; and a single stone, 8 feet in length, forms the floor of the latter; there are sill-stones in these chambers also. On the south side of the mound another opening discloses two chambers, some of the stones of which have a great variety of carving (fig. 38). In 1885 further excavations were undertaken by the Board of Works, and, to the south of the passage leading to the first set of chambers, a short curved passage with steps was discovered, terminating at each end in a circular cell. The character of this work, and the kind of stones used—that of an ordinary field size—show that the structure was of a much later date, being of the usual souterrain type common in many parts of Ireland.

KNOWTH.

The third great tumulus of the Boyne group is at Knowth, less than one mile away, to the west towards Slane. It, too, was rifled by the Danes, but since that time it has not been entered. It is about 700 feet in circumference, and over 40 feet high, and for many years was used as a quarry by those requiring material for house-building or mending roads.

Among the objects found about these tumuli were a gold coin of Valentinian, one of Theodosius, a denarius of Geta, a gold chain, two finger-rings, two gold torcs, and some bronze and iron objects. These, however, should be considered with great care in determining the age of the tumuli: the later construction and occupation of the chamber at Dowth and the visits of the Danes are sufficient to account for those objects of a late date. Taking the character of the architecture into consideration, the nature of the ornamentation, and the objects found, expert opinion assigns the tumuli to the Early Bronze Period, and makes Newgrange the oldest member of the group.

MELLIFONT ABBEY.

About four miles north of Newgrange stand the ruins of the first Cistercian monastery established in Ireland. This was due to Malachy O'Morgair, Archbishop of Armagh. He visited St. Bernard at Clairvaux, and a lasting friendship was created between them ; and it was here, when on another visit eight years later, that Malachy died, and St. Bernard wrote his "Life." Donough O'Carroll, prince of Oriel, gave a grant of land on the banks of the river Mattock, and a monastery on the lines of those of the great Cistercian order was founded in 1142. Many others soon followed, and by the time of the coming of the Normans twenty-nine monasteries of this order were established throughout the land ; but the Abbot of Mellifont took precedence of all the Cistercian abbots in Ireland. In 1157 an important synod was held here, attended by the primate Gelasius, seventeen bishops, and four provincial kings. Henry II specially favoured Mellifont, and granted it a charter, as did also King John. In 1190 Malachy was canonised by Clement III. The monastery was richly endowed by Dervorgilla, wife of Tiernan O'Rourke, whose abduction by Dermot MacMurrough was the immediate cause of the Anglo-Norman invasion ; here she died, but the site of her tomb is now unknown. The abbey became rich and prosperous in the course of time, and at the suppression of the monasteries in 1539 it contained 140 monks, besides lay brothers and servitors ; and the abbot owned 4,000 acres of land, extending along the south bank of the Boyne. In 1566 Mellifont and its great possessions passed into the hands of Edward Moore, afterwards knighted, and ancestor of the Marquis of Drogheda. In 1727 the abbey became by purchase the property of Mr. Balfour of Townley Hall, and it has remained in the hands of his successors since that time.

The ruins are prettily situated on the banks of the Mattock, which here divides the counties of Meath and Louth (Plate XVIII). The approach is by the ruins of the porter's lodge, a massive square tower, which rises on one side to a considerable height. On either side of this originally stood a

PLATE XVIII.

[*To face page 274.*



MELLIFONT ABBEY.
(From a photograph by W. Lawrence, Dublin.)





range of buildings for the reception of strangers, and portions of the old encircling wall may still be traced. According to the usual plan of the Cistercian monasteries, the space between the gate-house and the church was occupied by a pile of buildings, rectangular in plan, of which the church formed one side. Of the latter, which lies to the left, little now remains ; it was cruciform in plan, as can be distinguished by a series of concrete blocks, marking the site of the nave piers. The nave had seven bays and was probably 120 feet in length ; and the breadth, including the aisles, was 54 feet ; the width across the transepts was 116 feet. In the north wall of the north transept is a fine doorway, an exceptional feature in a Cistercian church, with jambs of clustered pillars. In the excavations under the direction of the Board of Works two semicircular chapels were shown to have existed in each transept in a line with the high altar, as at Clairvaux. The foundation of the altar remains, at a few feet distant from the east wall. The chancel was 46 feet long and 26 feet wide ; on the south side are a piscina and the remains of a sedilia, and under the latter a tomb was found during the excavations. On the north side is an arched tomb-recess with an ornamental moulding. Mellifont underwent several changes during the successive developments of style in Gothic architecture in the middle ages, and by the fifteenth century little was left of the early foundation. The cloisters were entered from the south side, and of these but the bare traces now remain. On the left is the chapter-house, generally known as St. Bernard's chapel. It is 30 feet long and nearly 19 feet wide, and originally consisted of a lower and an upper chamber, the latter probably being the muniment-room. It has a beautifully groined roof, and three sets of arches which spring from clustered columns with capitals carved in foliage. The centre column runs to the ground, but the others end at a basement a short height from the floor. It is lit by an east window and two side-windows of decorated style, with rather heavy mullions, but good tracery ; these have been restored. A quantity of cut stone-work and tiles, which were collected about the grounds and among the ruins during the excavations, are

now stored here. Without is an interesting building, which was entered from the cloisters, and is usually called the "baptistery." It was octagonal in shape, and but five sides now remain ; it measured 29 feet across, and the original height was about 80 feet. There was a semicircular arched opening in each face, the arch springing from pillars with foliage-carved capitals ; above the crown of the arches is a string-course. All the roof is gone but the fluted columns. The corbels and groins within show where the arches rose that supported it ; the upper story was lit by two windows which now show no architectural details. This building was really the lavatory, which was entered from the cloisters, and the monks, having washed their hands in basins from a central fountain, then passed into the refectory opposite to it. In the work of excavation, drains were found in connexion with the building.

MONASTERBOICE.

About four miles to the north is Monasterboice, which contains in its group of ecclesiastical antiquities two pieces of sculpture of exceptional interest. This group consists of two churches, three high crosses and a round tower. The early religious establishment which existed here is ascribed to St. Buithe or Boetius, who founded it about the end of the fifth century, and from whom it derives its name. St. Buithe died on the day St. Columba was born, and was buried at Monasterboice ; he is said to have foretold St. Columba's birth. The annals of Monasterboice are not marked by any events of importance, with the exception of the destruction of its belfry by fire in 1097. The churches are of different dates, that standing a little to the north-east of the round tower being the earlier. It was entered by a square-headed doorway in the west gable, and seems to have formerly consisted of a nave and chancel, which were separated by a semicircular arch, now fallen ; the chancel, too, has disappeared. The second church is more modern, and has been attributed to the thirteenth century ; it was entered by a low round-headed doorway.

The Round Tower is considered by Petrie to date from





THE GREAT CROSS, MONASTERBOICE, CO. LOUTH.
(From Miss Stokes' "Early Christian Art in Ireland.")

the ninth century; Miss Stokes places it a century later. It is about 51 feet in circumference at the base, and 110 feet high. A special feature is the doorway, which is 6 feet from the ground; and the head is cut out of two stones, one laid horizontally over the other. A band runs round the head and down the sides of the doorway to the level of the sill, and then runs horizontally for about 8 inches, ascends and passes round the head, thus forming a kind of a double band. Above the doorway is a pointed window; the remainder are square-headed. The Board of Works has repaired this tower, and placed steps from floor to floor, so that the summit can be reached, from which a fine view is obtained.

The two Crosses at Monasterboice are perhaps the finest now remaining in Ireland, and are remarkable examples of the high degree of perfection to which Irish sculpture of this kind had attained in the early middle ages. The Great Cross (Plate XIX) stands 27 feet high, and was sculptured in three sections: the shaft, the ring and arms, and the top piece. The shaft where it joins the base is 2 feet broad and 15 inches thick. The west side is divided by fillets into seven panels, each containing two or more figures, which are now much worn by exposure to the air and rain of many centuries. The lowest panel is much disfigured, through an attempt made to throw down the cross. In the top panel above, where it runs into the binding ring, is a representation of the Crucifixion, with the usual figures of a soldier on each side, one piercing the body, and the other offering a sponge. The body of the cross, consisting of arms and ring, measures 6 feet 8 inches: the figures on the right are seen to be in the act of adoration; those on the left are obscure, being much worn. The cap is shrine-shaped, and is 2 feet 3 inches high; there are altogether twenty-two panels, of which only nine have been deciphered with any degree of satisfaction. They are: the fall of man, expulsion from Eden, Adam delving and Eve spinning, Cain slaying Abel, the worship of the Magi, the three warriors before David, Michael and Satan weighing souls, the Crucifixion, and the last Judgment.

The second or Muiredach's Cross (Plate XX) is much

smaller, but better preserved ; it is 15 feet high, 6 feet in breadth across the arms ; and the shaft at the base is $2\frac{1}{2}$ feet in breadth and 1 foot 9 inches thick, diminishing slightly upwards ; its sides are divided by twisted bands into panels, each of which contains sculptured figures, intricate designs, or animals. There are three panels in the west face of the shaft, and the figures are of much interest, as they show the type of dress, ecclesiastical and military, used by the Irish



FIG. 39.—Detail from Muiredach's Cross, Monasterboice.

in the ninth and tenth centuries. In the lowest is a figure in a long cloak, staff in hand, between two figures armed with long swords (fig. 39). In the centre the figures are in ecclesiastical garb, each holding a book. In the third the figures are in long, flowing dresses, the one in the centre seemingly giving his staff to one and his book to the other. At the foot of the shaft are two dogs couchant ; the centre



THE CROSS OF MUIREDACH, MONASTERBOICE, CO. LOUTH.

(From a photograph by W. Lawrence, Dublin.)





of the head has a figure of the Crucifixion as in the larger cross ; in the same place, on the east face, Christ is sitting in judgment ; a choir of angels fills the arm to the right, several being represented with musical instruments, in which the harp appears, resting on the knees of the Psalmist, and on the harp lights the Holy Spirit in the form of a dove. The space on the left is crowded with figures doomed to punishment, and a fiend with a trident drives them from the throne. Beneath is the Archangel Michael, weighing souls. The next division has a representation of the adoration of the Magi. The third and fourth panels are obscure ; in the latter is a seated figure blowing a horn, with soldiers crowding round. The last contains the temptation of Adam and Eve and their expulsion from the Garden of Eden. On the base are two dogs fighting, one holding the other by the ear. On the northern arm, to the left of the Crucifixion and underneath, is a representation of the *dextera Dei*, or hand-symbol used in early Christian art to represent the First Person of the Trinity. An inscription on the lower part of the west side of the shaft runs, "A prayer for Muiredach by whom was made the Cross." There were two of that name connected with Monasterboice according to Irish annals, one an abbot in 844 and the other in 924 ; but which of them erected the cross remains a matter of uncertainty. As the latter was a man of greater distinction, and probably wealth, he is more likely to have been the founder. The Cromwellian soldiers bear the odium of having broken the third cross, which is very imperfect, the head and part of the shaft only remaining uninjured.

TRIM.

(Contributed by T. J. WESTROPP, M.A., M.R.I.A.)

This most interesting old place is the ancient "Ath trium" of the Lives of St. Patrick, a frontier town and castle of the English, and in later years closely connected with the youth of the Duke of Wellington. We can barely enumerate the ruins. The castle, with a large enclosure, with fosse, curtain walls, towers, and gates, is dominated by a massive

keep, square, with square side-turrets in the middle of each face. The church of St. Patrick retains its picturesque belfry, ruined chancel, with a handsome side-window, curious tombs, and a font, carved with grotesque animals. The great abbey of St. Mary, whose famous image ("the idol of Trim" of the ultra-reformers) is believed to be the fine statue of the Virgin preserved in the Carmelite Convent, Dublin, has only the noble shattered belfry and some foundations to mark its site. Eastward, beside the Boyne, about a mile from Trim, is Newtown, with the ruins of a fine church, a little church embodying the monumental effigy of the first English bishop (as reputed), and an interesting Hospital of St. John. The views of the ruins from the different points of this walk are charmingly picturesque.¹

SKETCH OF THE HISTORY OF DUBLIN.

BY C. LITTON FALKNER, M.A., M.R.I.A.

It is a curious circumstance which has often been noted that the story of the Irish capital does not become the story of the capital of the Irish people until a period long subsequent to the first foundation of Dublin. Although the Irish annalists make occasional mention of the site of the future city of Dublin by its earliest name of Ath Cliath, or Ath Cliath i Cualu, from the district of Cualain, a territory corresponding to the diocese of Glendalough, it is not until the end of the eighth century that vague tradition and unauthenticated legend begin to crystallize into history with the coming of the Norse invader. Owing its origin to Danish auspices, Dublin was neither first built by Irish hands, nor originally peopled by men of Irish race. To the Ireland of the ages before the advent of the Vikings, the spot round which the city was

¹ See Eugene A. Conwell, "A Tour in Trim," Journal Royal Hist. and Arch. Soc. (Roy. Soc. Antiquaries Journal), vol. xii., consec. ser. (1872-3), p. 361.

to rise had no doubt always been a place of some importance. For its maritime situation must from the earliest times have necessitated some sort of assemblage of dwellings near the junction of the River Liffey with the Irish Sea. But there is nothing to indicate that either in pre-Christian or early Christian times the ancient Ath Cliath had reached a position of consequence. Until the Danes had fixed their seat in the immediate neighbourhood, no Leinster chieftain or Irish king appears to have chosen the place for stronghold or for residence. Even during the first hundred years of its Norse ownership, it is improbable that any considerable town can have grown up. Indeed, both the name originally given to the place by the native Irish and the later one, likewise of Gaelic origin, which the Scandinavian invaders adopted, indicate that the early importance of the spot was geographical rather than political, and arose less from any settlement of which it had become the site than from the different uses, appropriate to the physical features of the locality, to which the Celt and the Norseman respectively put it. To the former it was Ath Cliath, the ford bridged by hurdles, which formed the most direct means of communication between the ancient kingdoms of Meath and Leinster; and as such it is said, but without any sufficient authority, to have been utilized by St. Patrick when making his way from Wicklow to Armagh. To the latter it was Dubhlinn, the dark pool or haven lying eastward of the ford, a little further down the river, in which the warships of the Viking might find safe harbourage in the course of his marauding visits to the Irish coast.

The earliest ravages of the Danes in Ireland commenced towards the close of the eighth century; but it was not until the year 887 that the Vikings paid their first recorded visit to Dublin. In that year there came "three score and five ships and landed at Dubhlinn of Ath Cliath" to plunder the adjacent territory. This was the prelude to the incursions of the Finn Gaill or Fair Strangers, the memory of whose settlement in the district north-west of Dublin is embalmed in its name of Fingal. Their advent seems to have been followed within a year or two by the

erection of the first recorded building in Dublin, a fortress or fixed encampment which, ten years later, was destroyed by a fresh horde of Northmen. The new-comers represented a different branch of the Scandinavian stock, and are called by the annalists Dubh Gaill, or the Dark Strangers. For some time after their arrival the story of Ireland is a succession of struggles between the two opposite elements in the Scandinavian immigration ; but about the middle of the ninth century this antagonism terminated in the general recognition of Aulaf or Olaf the White by all sections of the invaders. It was by this coalition that the Scandinavian power in Ireland was permanently consolidated ; and it is in King Aulaf that we are to recognize the true founder of Dublin. In 851, according to the chronicles of the Four Masters, "Aulaiv, son of the king of Loch-lann, came into Ireland, and all the foreigners submitted to him, and had rent from the Irish."

For above a century and a half from the establishment of Aulaf's authority, Dublin was the centre of that important Viking confederacy, stretching from Carlingford to Waterford, to which the name of Scandinavian Kingdom of Dublin has been applied. But it is not to be supposed that the Danish supremacy was left unchallenged throughout this long period. The story of the early wars of Ireland after the coming of the Norsemen contains the record of more than one struggle between the native and the alien race for the possession of that fortress by means of which the Danish kings of Dublin sought to buttress their power, and which was to form the nucleus of the future capital. In these contests there were many vicissitudes, and fortune was fickle with her favours. But, though the Irish had their triumphs, they were, for a long period, temporary and barren ; whereas from the date of the great battle, fought on October 17th, 917, on the banks of the Liffey, within a mile or so of the very site of the original Ath Cliath, until that of the still greater Battle of Clontarf, fought close on a century later, the Danish supremacy in Dublin was complete and unbroken. And although the famous victory of Brian Borumha in 1014 effected the expulsion of the foreigner from Meath and

Leinster, it did not effectually achieve the deliverance of Dublin from foreign rule. For above half a century after Clontarf, the city remained in Danish hands. Down to the time of the coming of the Normans, Dublin continued to be, predominantly at least, the city of the Ostmen, as the Norse inhabitants had come to be known. It was by a garrison of Ostmen that in 1170 it was stoutly, though ineffectually, held against Strongbow and his followers. Thus it is that the oldest memorials which Dublin has to boast are those of its early Norse owners, and that its pre-Norman remains are of Scandinavian rather than of Gaelic origin. Its oldest cathedral—Christchurch—was founded almost a quarter of a century after the Battle of Clontarf by Sitric, its Danish king. Its oldest church, St. Michan's, recalls a Danish saint. And an important quarter of the modern city, on the north bank of the Liffey, has but lately lost its long-preserved name of Oxmantown or Ostmanstown.

But if the earliest traditions of Dublin are undoubtedly those which connect the city with its Norse founders, its earliest authenticated records are as unquestionably Norman. Beyond the associations just mentioned, there is little, if anything, to identify the Dublin of to-day with the capital of the Scandinavian kingdom; or to indicate what manner of city it was that on St. Matthew's Day, September 21st, 1170, after its abandonment by the Danish king, Hasculf McTorkil, surrendered to Strongbow and his valiant lieutenant Miles de Cogan; and which, after the abortive attempt at recapture by a Danish squadron under the dispossessed sovereign, was to become the central stronghold of Norman authority in Ireland. It is impossible to affirm decisively that the fortress of king Aulaf once stood on or near the site of the "royal palace roofed with wattles after the fashion of the country," which Henry II., on his first arrival in Dublin in 1174, erected for the accommodation of his Court at Christmastide. But it is at least extremely probable that it was so. For the physical configuration of the rising ground to the south-east of the city-walls must at all times have suggested the eminence on which Dublin Castle now

stands as the most appropriate site for a fortress. Thus it may well have been that the battlements of the watch-tower from which king Sitric had followed the varying fortunes of the fight at Clontarf rose from the self-same spot on which for seven centuries His Majesty's castle of Dublin has been the citadel of the governing authority in Ireland. But however that may be, no trace of the Danish fortress survived the final overthrow of Scandinavian power; and it is really with king John's order for the construction of "a strong fortress in Dublin, suitable both for the administration of justice and, if need be, for the defence of the city," that the history of Dublin, considered as a metropolis, must be said to begin.

The Norman captors of the Danish town had received from Henry II the charter under which Dublin was to remain, during the long Plantagenet era, the one secure stronghold of English power in an island only half subdued. After the expulsion of the Norsemen, the sovereign "granted to his men of Bristol his City of Dublin to inhabit and to hold of him, and of his heirs for ever, with all the liberties and free customs which his men of Bristol then enjoyed at Bristol, and through all England." This charter, subsequently confirmed by king John and others of Henry's successors, gave to the city and its inhabitants an impress which lasted down to Stuart times. "It is resembled to Bristol, but falleth short," was the verdict of an English visitor in the time of James I. The people of Dublin long retained the mercantile characteristics of the great capital of the west of England; and the parish church of St. Werburgh's, dedicated to the patron saint of one of the earliest of Bristol churches, still bears witness to the connexion between the two cities. The essentially alien character of Dublin, as thus colonized, is well illustrated by the fact that its citizens were long a prey to the depredations of the Irish septs who dwelt within its neighbourhood. Easter Monday of the year 1209 was marked by a memorable raid by the O'Byrnes and O'Tooles, who, descending unexpectedly on the holiday-making citizens, drove them within the city walls, after a slaughter which caused the day long to be remembered in the capital as Black Monday. And

Stanhurst, the sixteenth-century chronicler, has recorded how, at a somewhat later date, the Irish enemy carried their raids on one occasion even into the precincts of the Court of Exchequer, “where, surprising the unweaponed multitude, they committed terrible slaughter by sparing none that came under their dint, and withal, as far as their Scarborough leisure would serve them, they ransacked the prince’s treasure.”

It was doubtless upon some such provocation as this that the work of building the castle and raising the walls of Dublin was ordered and enforced by King John. To that monarch, who as Lord of Ireland had a peculiar interest in his father’s conquest long before he succeeded to the English Crown, Dublin was perfectly familiar, and he thoroughly understood its needs. The first instructions for the building of the castle were issued to the Justiciary, Meiller FitzHenry; but it is to a Norman Archbishop of Dublin, Henri de Londres, that the honour of its erection is really due. The fortress appears to have been completed about the year 1220, and the city walls a few years later. But both castle and city underwent considerable expansion at the hands of the Viceroy of the early Plantagenet sovereigns. Henry III gave orders for the erection of a great hall, 120 feet in length and 80 in breadth, “with glazed windows after the manner of the Hall of Canterbury,” a building which in later days appears to have served as the place of meeting for the earlier Irish Parliaments; and it was at the behest of the same monarch that a splendid chapel was raised within the castle precincts to the honour of Edward the Confessor. There is not much of external splendour about Dublin Castle as it exists to-day; but there can be little doubt that, as conceived by its Plantagenet founders, it was intended to be a pile worthy to be the principal edifice of a stately capital.

The limits of the medieval city, as encompassed by the walls and turrets designed to defend it, were far from extensive. From the date of its first origin, as the seat of a settled political system, Dublin has a history of over seven centuries, in the course of which the metropolis has from time to time been extended, until at the present day its

limits have come to embrace an area of close on eight thousand acres, and to contain a population of nearly three hundred thousand. But these imposing figures have only recently been attained by the inclusion within the city boundaries of several of what until recently were deemed its northern and western suburbs; and down to the year 1900 the city of Dublin had long been understood to mean the area within the North and South Circular Roads, a circumference of about nine miles. But the walls of the medieval city were much less extensive, and can hardly have measured more than an Irish mile, or encompassed an area much larger than that now enclosed in St. Stephen's Green. Its dimensions can be gauged with fair accuracy from the accompanying map (fig. 40), by which it will be seen that the city lay along the south bank of the Liffey, whose waters at high tide ran right up to the walls from a point just below the castle, at which Grattan Bridge now spans the river, to the Old Bridge; the whole forming an irregular quadrangle, near the middle of which stood Christchurch Cathedral. Although portions of the ancient walls are still discernible, their traces are of the faintest, only St. Audoen's Arch surviving to show the precise situation of one of the eight city gates. But no substantial change in the boundaries of the capital having taken place between the thirteenth and seventeenth centuries, a late Elizabethan description of "the whole circuit of the city walls" enables us to gain a fair notion of the character of the medieval town. The walls were about 17 feet high, with a breadth of 4 or 5 feet, and the numerous towers by which they were defended varied from 16 to 40 feet in height. Within was a rampart, 15 feet thick, and the walls were stoutly buttressed at various points without. The gates, of which the chief was Newgate, were of imposing dimensions.

Few studies in historical topography can have more real interest than the analysis of the process by which so many of the great cities of modern Europe have been gradually developed from the walled enclosures, which were indispensable conditions of a medieval town, into the spacious and

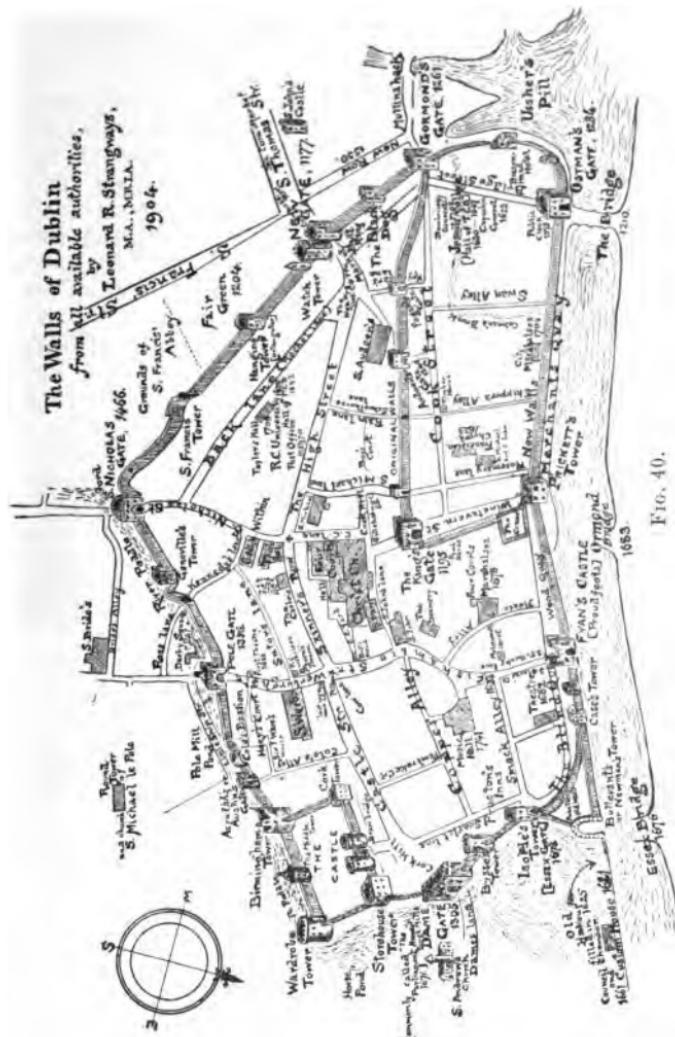


FIG. 40.

unrestricted amplitude of a twentieth-century metropolis. In the case of Dublin the process is peculiarly well marked and easy to trace, and is the work in the main of three great periods of expansive growth. As late as the era of the Commonwealth, Dublin still remained a walled town, within the ambit of whose fortifications few changes affecting its general aspect had taken place for a couple of centuries. From the days of the later Plantagenets to those of the later Stuarts, it may be said with little exaggeration that no changes on a scale large enough to affect its general configuration were wrought in the appearance of the capital or in its geographical outline. Some extensions of the residential quarter had indeed taken place in the closing years of the sixteenth century, the erection of Trinity College on the site of the old monastery of All Hallows naturally leading to the occupation of the intervening area between College Green and Dublin Castle, now traversed by the spacious thoroughfare of Dame Street. Thus, almost contemporaneously with the foundation of the University, the site on which the Parliament Buildings in College Green—now the Bank of Ireland—were subsequently raised was utilized for the first time by the well-known statesman and soldier, Sir George Carew, for the building at first called Cary's Hospital, but afterwards known as Chichester House, from the name of its owner under James I, the celebrated Lord Deputy, Sir Arthur Chichester. But no attempt had as yet been made to enlarge the metropolis, either to the north, where the ancient Oxmantown still sufficed for all the inhabitants of Dublin on that side of the river, or to the south-east, where the modern enclosure of St. Stephen's Green was still a common. And along the line of the southern quays, already antiquated to our twentieth-century eyes, fresh meadows ran from the river banks to the old Priory of Kilmainham.

But the Restoration was to change all that. Under the auspices of an illustrious Irishman, the first Duke of Ormond, who held office as Lord Lieutenant for fifteen of the last twenty-five years of the *de facto* reign of Charles II, a remarkable transformation was effected. Ormond, and those who with him constituted the viceregal court, had,

like so many of the followers of his sovereign, passed more than ten years in an enforced exile in the cities of the continent. The experience was not without a marked educational influence on the exiled cavaliers, who returned from abroad with new and liberal ideas of what a capital ought to be. The walled medieval city, which, as late as 1649, had endured a siege in much the same form in which an attack might have been conducted two centuries earlier, speedily vanished before the more advanced notions of the returned royalists. Houses everywhere sprang up without the walls of Dublin. The space from Cork Hill to College Green, previously but sparsely occupied, was speedily filled up; and the quays began to be formed. On the north bank of the river, Oxmantown Green was so largely encroached upon that St. Stephen's Green, which was first walled in about this time, had to be requisitioned as an exercise-ground for the garrison. The capital grew so quickly that it was noted in 1673 by Lord Essex, one of the Restoration Viceroys, that "the city of Dublin is now very near, if not altogether, twice as big as it was at His Majesty's Restoration, and did till the Dutch war began every day increase in building." So rapid was the extension that some of the old-fashioned citizens, accustomed to rely for security on the protection of the city walls, were filled with alarm, and felt obliged to warn the Lord Lieutenant of the dangers likely to be occasioned in time of war by the large number of dwellings which had sprung up outside the defences of the city. But, apart from the actual extension of streets and buildings throughout this period, the era of the Restoration was marked in Dublin by two great and abiding memorials of the public spirit and enterprise of its seventeenth-century rulers and citizens. The formation of the splendid recreation-grounds of the Phoenix Park, and the enclosure of the spacious area of St. Stephen's Green, at opposite sides of the city, produced a marked effect on the conditions of the further development of Dublin. The Phoenix Park, from the moment it was provided, enormously enhanced the amenities of residence in Dublin. And, although a full century was to elapse before residential Dublin transgressed beyond the

eastern limits of St. Stephen's Green, the permanent dedication of so large an area as an open-air space has had an abiding effect on the aspect and atmosphere of the modern city.

Of these two improvements, the first was the work of the Viceroy, the second of the municipality. The germ of the Phoenix Park was found in certain Crown lands, which, having originally formed portion of the possessions granted to the Priory of the Knights Hospitallers at Kilmainham, had been resumed by the Crown on the suppression of the monasteries. To this nucleus Ormond added extensively by the purchase of adjacent property to the north and west; so that, as first designed, the Park comprised above 2,000 acres, including the area south of the river now forming the grounds of the Royal Hospital—another monument of post-Restoration magnificence. The Park was not designed by Ormond as the seat of the Viceregal residence; and the present Viceregal Lodge became so only by purchase from a private owner, who, towards the close of the eighteenth century, had been permitted to build a residence in connexion with his office of Ranger of the Phoenix Park. But in its present state the Park, as a whole, owes much to the care and interest of a succession of Viceroys, notably of the celebrated Lord Chesterfield, who took a lively interest in its plantations, and by whom the Phoenix Column in the centre of its principal drive was erected.

St. Stephen's Green, on the other hand, owes its origin to municipal auspices, stimulated in part by the pressure of financial exigency, and in part by the spirit of emulation and zeal for improvement which was abroad under the Duke of Ormond's *régime*. The confusion of the Civil War had worked havoc alike with the material prosperity of the general body of the citizens of Dublin and with the municipal finances. The State Papers of the time depict in mournful colours the ruin and indigence wrought in the course of the long struggle, which in Dublin had been marked by all the horrors of a sustained siege and the desolation inevitably produced by the constant apprehensions of military assault. Accordingly the city fathers

could find no better means of replenishing an exhausted exchequer than by letting out the lands round the common called St. Stephen's Green as building lots, at the same time providing for the enclosure of the central space. Although the allotments were taken up by persons of wealth and position, it was not until the succeeding century that the building ground was fully utilized. But in the early half of the eighteenth century the Green became the centre of fashionable Dublin, and the Beaux' Walk, along its northern side, was long the chief resort of the leaders of Dublin society. Down to a late period in the nineteenth century St. Stephen's Green was maintained at the expense of the residents. It owes its present splendour as a public park solely to the munificence of Lord Ardilaun, who, in 1880, carried out, at a cost of £20,000, the scenic transformation which has converted it from an ordinary city square into one of the handsomest of city parks. Besides these two great alterations in the geographical aspect of the city and its environs, two striking memorials of the reign of Charles II survive in Dublin. The first is the stately building near its western boundaries known as the Royal Hospital, an institution similar to Chelsea Hospital, which was built towards the close of the reign from the design of Sir Christopher Wren on the site of the ancient Hospital of the Knights of St. John. The second is the Hospital or Free School of Charles II, better known as the Blue Coat School, founded and endowed by the liberality of the citizens of Dublin, acting under a Royal Charter. But in the latter case the original Caroline building has given place to an eighteenth-century successor.

With the close of Charles the Second's reign and the ensuing political disturbances, a period was put to the development of Dublin under the Stuarts; and it was not until the reign of George II that those extensive additions began to be made which render the latter half of the eighteenth century the grand period in the architectural adornment of the Irish capital. But the interval between the accession of James II and the demise of George I, though unmarked by any striking memorials, was, never-

theless, characterized by a gradual development of certain districts theretofore but sparsely inhabited, or even wholly waste, whose occupation was an essential preliminary to the more imposing additions of the succeeding age. Thus the considerable territory between the enclosure of the College Park and the river had become so thickly populated as to necessitate the erection of a new parish, now known as St. Mark's; and some progress was made towards the inhabiting of the low-lying lands immediately adjacent to the north-eastern bank of the Liffey. These extensions were in part the effect of the pronounced development of the city along the banks of the river in an easterly direction, which its growing wealth and prosperity rendered necessary. But they were in part also due to the important enlargement of the port of Dublin by the clearing of the river channel for the better accommodation of shipping. This was an improvement which ultimately transformed the neighbourhood from a wilderness of slough and slob into the busy hive of railway and river-side enterprise of which it has more recently become the scene; but its most immediate and most conspicuous effect was the laying out of Sackville Street and its adjacent northerly extensions—thoroughfares which the subsequent construction of Carlisle, now O'Connell, Bridge first brought into direct contact and communication with the centre of the modern capital.

The age of Queen Anne, which in England has left so clear an architectural imprint, has but few memorials in Dublin. No great building of the first rank survives to recall that era, unless it be the fine Library of Trinity College, which, however, though begun in Queen Anne's reign, was not completed till 1732; and, though the period was marked by a good deal of rebuilding on old sites, the houses then erected have given place for the most part to the more spacious residences of a later time. The main importance of this period in the history of Dublin lies not so much in its visible enlargement as in the extension of its local and municipal institutions, more than one of which, such as the Port and Docks Board, date from the beginning of the eighteenth century. The development of

the linen trade, and the diffusion throughout the country of a spirit of mercantile enterprise, which, though it has unfortunately not been maintained, was a very marked feature of the early part of the eighteenth century, exercised a direct effect upon the progress of the Irish capital; and to this increased commercial prosperity must be attributed in a great degree that marvellous outburst of architectural enterprise which marked the reign of George II and his successors, and which has left such indelible marks on the face of the city.

For, in its essential features, in almost all that attracts the attention of the passing traveller, the Dublin of to-day is still the Dublin of the closing years of the eighteenth century. With the exception of the cathedrals of Christ-church and St. Patrick's, the only buildings of real antiquity which it contains, almost every structure of interest, and every characteristic feature of the capital, apart from its natural environs, are memorials of that period. Of those public buildings upon which Dublin now prides itself, the Royal Hospital at Kilmainham is almost the only one which existed in the seventeenth century, and curiously few were added in the nineteenth. Of the great distinctive features in the centre of the modern city, the Parliament House, now the Bank of Ireland, was built in the reign of George II; and the great façade of Trinity College, erected at the cost of the Irish Parliament, dates from that of his successor. Modern municipalities have often indulged in lavish expenditure for the housing of their civic councils; but the handsome meeting-place of the Corporation of Dublin has only been adapted from the Royal Exchange of the eighteenth century, whilst the Four Courts and the Custom House, the two chief adornments of the River Liffey as it flows through the city, are monuments of architects of the same period. Nor are the memories of the most vivid period of Irish history in the Dublin of to-day confined to its public buildings. For the residential quarters of Dublin within the old city boundaries still belong as exclusively as its public edifices to the same period. The great squares commemorate in their names the Viceroys and nobility of the

Georgian era, and few of the more important streets were unbuilt a hundred years ago. Save the handsome Post-Office in Sackville Street, which dates from very early in the last century; the fine group of buildings round Leinster House, forming the National Gallery, Museum, and Library; and a few of the public statues; there is little in the configuration of the modern streets of Dublin which would be unfamiliar to an eighteenth-century citizen. In the last-named adornment, indeed, Dublin has never been opulent, and it was notably deficient in statues before the erection of those of Burke, Goldsmith, and Grattan, in College Green; of those of Nelson and O'Connell, in Sackville Street; and of the recently erected monument to Queen Victoria at Leinster House.

The best-known of books about Dublin, Sir John Gilbert's "History of Dublin," originated in its author's rambles as a young man through the streets of his native city, and in the memories which his well-stored mind enabled him to recognize as enshrined in the street-names affixed to the principal thoroughfares. And as there is no better stimulus to the faculty of historical imagination than the traditions which are preserved in the street-nomenclature of a modern city, so there is perhaps no better key by which a stranger interested in such associations can attempt to unlock the past than that which is afforded by the simple process of noting the names attached to its more important streets. In the case of Dublin this method of investigation is more than ordinarily simple, requiring for the most part no more elaborate equipment of historical lore than a list of the names of the statesmen who have represented the Sovereign in Ireland for the last two hundred and fifty years. The succession of the Viceroys of Ireland is embalmed in the names of the principal streets of the Irish capital; and whoever would trace the gradual development of Dublin has only to make himself acquainted with Viceregal chronology from the Restoration to the Union. For the order of its municipal development corresponds with curious precision with the order of the Viceregal succession, the name of each

succeeding Viceroy being stamped on each fresh extension of the streets of the metropolis. Thus, the earliest development of Dublin after the Restoration consisted, as already noted, in the extension of the quays on the north bank of the Liffey. Accordingly, we find in this extensive thoroughfare memorials of the chief governors of the period—Ormond Quay perpetuating the name of the great Duke of Ormond; Arran Quay that of his son Richard, Earl of Arran, who twice held office as deputy in his father's absence; and Essex—now Grattan—Bridge, preserving until quite recently the memory of another Restoration Viceroy. In the more modern additions to the city the same rule holds good. Grafton Street, Harcourt Street, and Westmoreland Street on the south side of the city; Bolton Street, Dorset Street, and Rutland Square on the north side, exhibit the order of the street extensions of the eighteenth century. The process might be minutely followed in the names of many of the lesser streets. It can be traced in a less noticeable but still remarkable degree in the case of nineteenth-century extensions in Dublin, and in the street-nomenclature of the various townships outside the borough boundary.

It has not been possible in such a sketch as this to attempt to exhibit the many remarkable events in the history of Ireland with which Dublin has direct associations. To do so would be to tell both too much and too little of the larger story of Ireland. For, though in one sense the story of the capital is the story of the country, the chronicle of Dublin can scarcely be said to abound in striking episodes. Since its capture by Strongbow's followers the incidents of its history have not often been exciting. In Plantagenet times its most thrilling experience was the imminence, in the reign of Edward II, of a siege at the hands of Edward Bruce, as the result of an invasion from Scotland which had very serious effects on the course of Irish history; but the Scottish commander stopped short of assaulting the city, and turned his arms in a different direction. Under the first of the Tudors the city was the scene of Lambert Simnel's brief masquerade in the character of the rightful King of England; the pretender being

crowned with all the pomp and circumstance of royalty in the cathedral of Christchurch. And, in the reign of Henry VIII, the capital witnessed the most serious revolt against English authority of which it has ever been the scene, when, in 1534, Lord Thomas FitzGerald, while governing the country in the absence of his father, the Earl of Kildare, who had been summoned to England on a charge of treason, laid siege to Dublin, and sought to carry Dublin Castle by storm. But the young Geraldine, who is known in history as Silken Thomas, was unable to cover his treason with the justification of success, and perished with his five uncles at Tyburn. In spite of the general unsettlement of the country, and the prolonged Irish wars which filled the reign of Queen Elizabeth, the close of the Tudor era was unmarked by any very notable event in Dublin history; and the close of Strafford's administration on the eve of the great Civil War was the occasion of the next outbreak by which the peace of the city was menaced. On October 28th, 1641, the Irish Rebellion was heralded by the abortive attempt of Sir Phelim O'Neill to surprise Dublin Castle, as the preliminary to the capture of the capital. But the Government of the day was served on this occasion by the treachery, or indiscretion, of one of the conspirators, and Dublin was spared the bloodshed which elsewhere characterized the outbreak of the insurrection. But, though the authority of the English Government was maintained throughout the struggles of the succeeding decade, Dublin was a witness of many vicissitudes of fortune, in the course of which the city and its citizens were severe sufferers. In the earlier part of the conflict between Cavalier and Roundhead, the Duke of Ormond, as Charles the First's vicegerent, had to meet the attack of the generals of the Catholic Confederation; but, though successful in repelling their assault, he was obliged a year or two later to surrender the capital of his sovereign into the hands of foes more formidable than the King's Irish enemies, and to abandon it to the Commissioners of the English Parliament. Two years later, in 1649, the death of the King having produced a temporary union among all factions in Ireland, the same Viceroy, who had

formerly defended the city, was called upon to besiege it. But Ormond's attack was foiled and his army completely dispersed by Michael Jones, the Parliamentary Governor of Dublin, at the Battle of Rathmines ; and thenceforward the capital remained in Cromwellian hands until the Restoration. That event, however, was greeted with enthusiasm by the citizens ; and Charles II was proclaimed in the Irish capital in a perfect delirium of loyalty.

Next, and most exciting of all perhaps among the incidents of Dublin history, comes the brief episode of James the Second's visit, when that monarch, exiled from two of his kingdoms, found a temporary refuge in the third, establishing himself in the Irish capital till the decisive defeat at the Boyne obliged him to abandon it. James was followed by another royal visitor in the person of William III, whose stay in Dublin is commemorated in Grinling Gibbons' famous equestrian statue of that monarch in College Green. The war of the Revolution was the last occasion on which Dublin experienced the excitement of actual hostilities ; and for more than a hundred years the peace of the city remained undisturbed by any formidable civil outbreak. The military disturbances of the seventeenth century gave place to the more peaceful, though scarcely less exciting, political agitations of the succeeding age, in which Swift, in the character of the author of the "Drapier's Letters," and Charles Lucas, a noisy but capable politician, whose statue by Edward Smyth still stands in the City Hall, were the central figures. In 1778 the celebrated meeting of the Ulster Volunteers in College Green was the prelude to the triumph of the patriot party in the Irish Parliament, and the restoration of those parliamentary liberties of Ireland which are inseparably associated with the splendid names of Flood and Grattan, but which in less than twenty years were to be extinguished as a consequence of the agitation of the United Irishmen and the rising of 1798. That insurrection, which was planned to commence on May 23rd of that year, was precipitated by the arrest in Dublin, two months earlier, of several of the chiefs of the movement, followed after a short interval by the capture and death in melancholy and

dramatic circumstances of its principal leader, the ill-fated and picturesque patriot Lord Edward FitzGerald. For some months after this event Dublin was under martial law, and its citizens were enrolled in yeomanry corps for the protection of the capital. An echo of the United Irish movement was heard five years later, when another brilliant apostle of popular principles headed the short-lived insurrection known as Robert Emmet's rising—an outbreak which proved a hopeless fiasco as a menace to the authority of the Government, but which was attended with melancholy results in the murder of Lord Kilwarden, the Irish Lord Chief Justice, and in the death on the scaffold of the romantic but misguided youth whose enthusiasm had hurried him into a foolhardy enterprise.

The history of Dublin during the nineteenth century is upon the whole a history of municipal prosperity and expansion. None of the great movements of the period can be said to have originated in Dublin. Nor are the chief triumphs of such great leaders of public opinion as O'Connell and Parnell associated in any particularly striking manner with the capital. The great agitations of the nineteenth century—the movement for Catholic Emancipation, the Young Ireland movement, the Fenian rising in 1867, the Land League agitation of more recent years—though all of them enjoyed in a greater or less degree the sympathy of the Dublin populace, were movements which left the surface of Dublin life practically untouched and untroubled. A melancholy exception is to be noted in the tragic crime known as the Phoenix Park murders in 1882, when Lord Frederick Cavendish and Mr. Burke were the victims of the Invincible conspiracy. In recent years Dublin has been happy in having no history, and its chronicles for the last quarter of a century have been fortunately filled with no more notable items than those which testify to the improvement in the appearance of its thoroughfares. The last generation has witnessed the adornment of some of the leading quarters of the city with such architectural successes as the Museum and Library in Kildare Street, and such triumphs of sculpture as the statue of O'Connell in Sackville Street; and last, but not

least, the public-spirited munificence of Lord Iveagh in clearing away the dilapidated houses in the neighbourhood of St. Patrick's Cathedral, and the creation of St. Patrick's Park, has effected a striking improvement in the amenities of the poorer quarters of the city.

CATHEDRALS AND CHURCHES OF DUBLIN.

BY JOHN COOKE, M.A., M.R.I.A.

Dublin is unique among the cities of the United Kingdom in possessing two cathedrals belonging to the same denomination. The **Cathedral of the Holy Trinity, or Christ-church**, the name by which it is best known, was originally founded in 1088 by Sigtryg, son of Aulaf, King of the Danes of Dublin. It is the opinion of the present architect, Sir Thomas Drew, that the crypt shows the original plan, which pier for pier corresponds with the cathedral of Waterford, also a Danish foundation of the same period. The character of Christchurch was completely altered in the years following the Anglo-Norman invasion at the instance of Laurence O'Toole, Archbishop of Dublin, and the expense of Strongbow, Fitzstephen, and Raymond le Gros. In 1168 it had been converted into a priory, the regular order of Arrosian canons superseding the old community of secular clergy. The successors of O'Toole looked coldly on the mixed Danish and Celtic independent establishment; and John Comyn, the first Anglo-Norman archbishop, founded a collegiate church without the city walls, and selected as a site the ancient church of St. Patrick; and in 1218 Henry de Loundres, who succeeded him, raised it to the status of a cathedral, modelled on that of Salisbury. Jealousy and rivalry existed between the two cathedrals; but in 1300 it was settled by an ordinance from Rome "that the Convent of Holy Trinity, as being the greater, the mother, and the elder church, should have the precedence in all rights and concerns of the Church." It suffered many vicissitudes in the subsequent centuries, and was the scene of many interesting events in the history of

the city. It served as the Chapel Royal down to 1814 ; and here until the sixteenth century the Lord Deputy and other officials of the State were sworn into office. It was in Christchurch that Lambert Simnel was crowned in 1486 by the Lords of the Council, led by the Earl of Kildare, then Lord Deputy, the Bishop of Meath being the preacher on that occasion. Mass was celebrated during the time of James II in Ireland, the tabernacle and candlesticks then used being still kept in the crypt; and William III celebrated his victories with a thank-offering of a magnificent service of plate to the cathedral. At the time of the disestablishment of the Irish Church the building was in a poor and mean condition, and shut in by an equally poor and mean mass of buildings and narrow streets. Much of these have been swept away, and the opening of Lord Edward Street in the more recent city improvements now affords an ample view of the great scheme of restoration, almost amounting to a rebuilding, due to the munificence of the late Mr. Henry Roe, a Dublin distiller. The work was carried out by Mr. George E. Street, the well-known architect; and the total cost, including endowment and the erection of the adjoining Synod House, is said to have amounted to £222,000 (Plate XXI).

On the south side lie the remains of the cloister garth of the ancient monastery excavated in 1886. The entrance to the south transept is by an old Norman doorway, removed from the north transept in 1881. From the south porch of the nave, steps lead to a covered-in bridge connecting the Cathedral with the Synod Hall and spanning the street. The Hall stands on the site, and retains the old tower of the church of St. Michael. Of the exterior, the dressing of the transept, the clerestory windows, the turrets over the north and south side-chapels, the belfry windows of the tower, and the roof and flying buttresses are new. The Caen stone used in the work already shows signs of weathering. The stone for which it was mistaken is said to have been a Somersetshire oolite of a very durable kind, and largely used in the erection of the medieval churches in the east of Ireland.

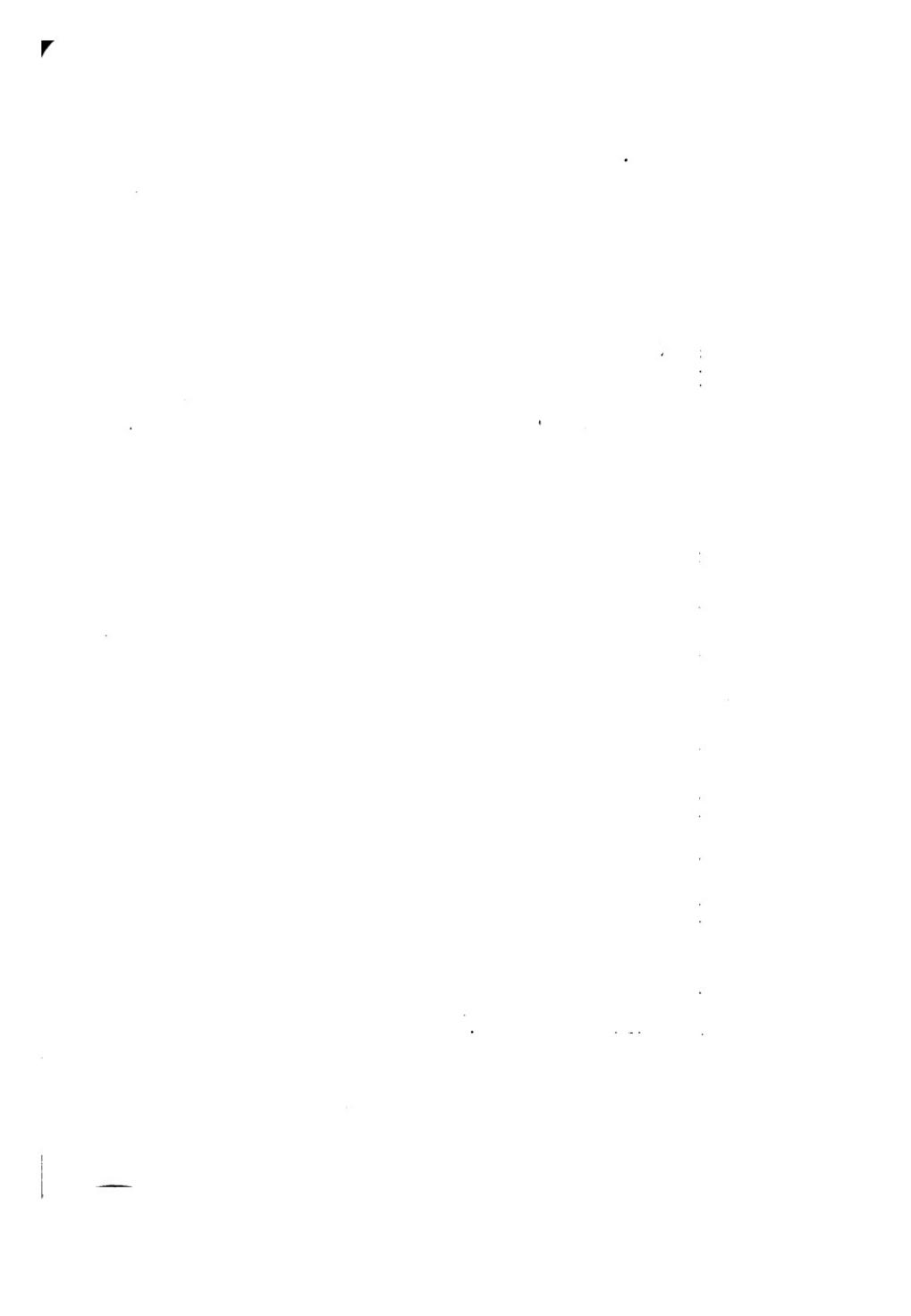
The nave, in the developed pointed style, dates from about

PLATE XXI.

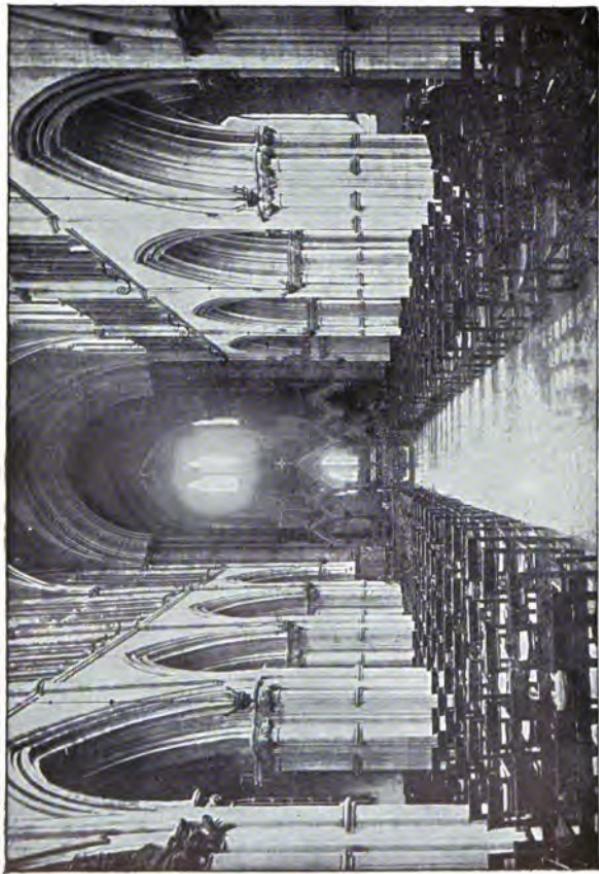
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CHRISTCHURCH CATHEDRAL, DUBLIN, FROM THE S.E.
(From a photograph by W. Lawrence, Dublin.)







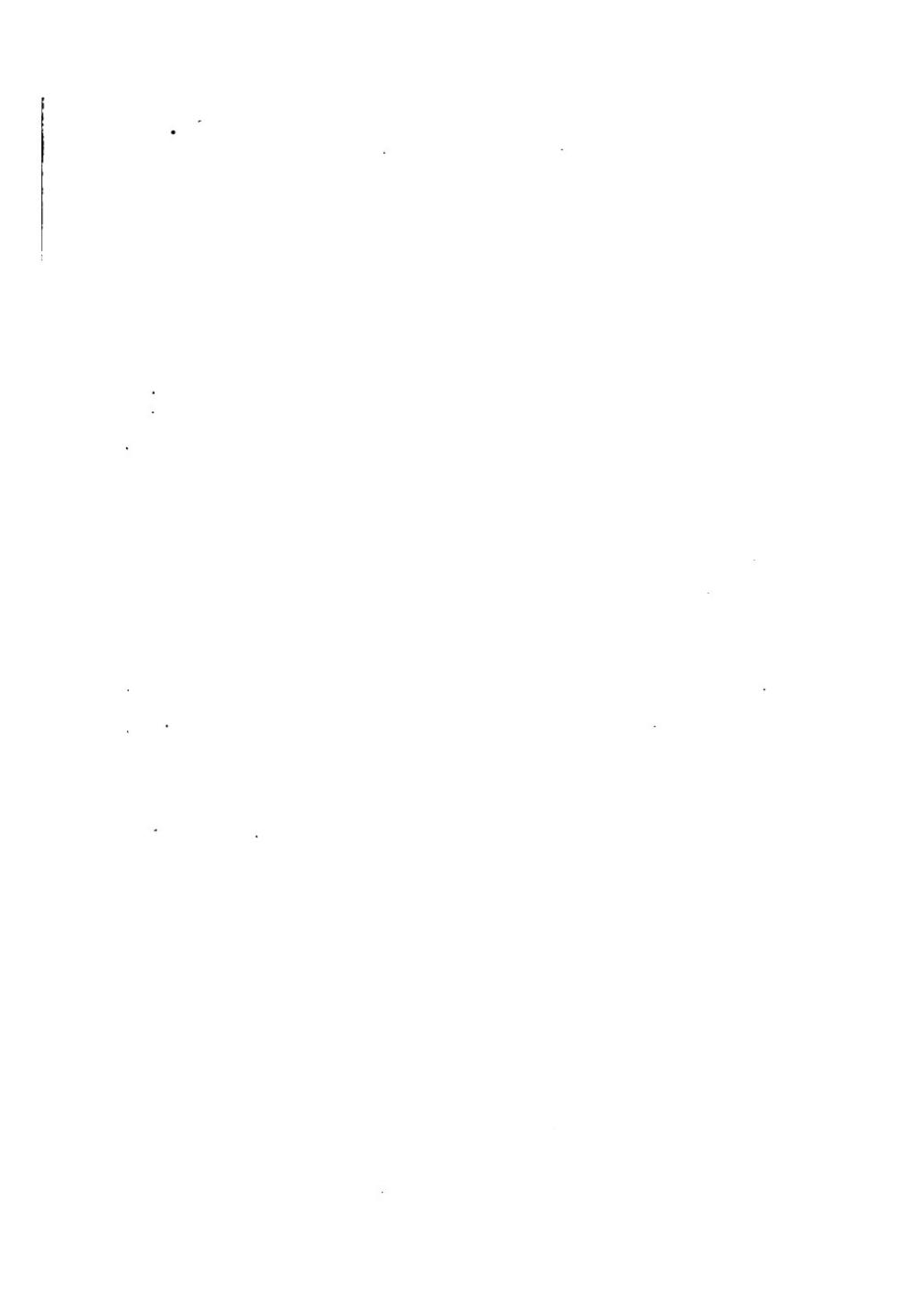
INTERIOR OF CHRISTCHURCH CATHEDRAL, DUBLIN.
(From a photograph by W. Lawrence, Dublin.)

1230, and shows the work of English masons of the Glastonbury school (Plate XXII). It consists of six bays, the western one on the north side showing evidence in the arch-mouldings and capitals that it was a subsequent erection. The north side is a careful restoration ; and the south wall is a complete rebuilding, replacing the sixteenth-century erection by Sir Henry Sydney after the fall of it and the roof in 1562. The débris was never entirely removed until 1875. As will be noticed, this destruction caused the north wall to hang out about two feet from the perpendicular. The west window and doorway are new, fragments of the old work being found sufficient for patterns to restore both on the original lines. The composition of the clerestory and triforium windows within one arch was justified by Mr. Street on the grounds that he had found lines of such in the old masonry. The work has been carried out with great care and finish. The nave and aisles were vaulted in stone ; and the thrust of the roof on the north side was resisted by the flying buttresses already mentioned. The great square piers supporting the central tower were altered by the addition of clustered marble shafts, and the old low arches were cut away, and new stone-moulded arches on the present line inserted 10 feet above the apex of the vaulting of the old. This was a risky undertaking, but successfully accomplished. The screen, which much interrupts the view of the choir and chapels, is entirely of modern design, and built on the fragmentary line of an older one. The cross which crowns it is modelled from the cross of Cong in the National Museum. The floor is a true reproduction of the thirteenth-century tiling, taken from fragments found under the refuse of the fallen roof. The Baptistry is a new feature by Mr. Street, based on details of a northern porch found at the restoration ; the stained glass is a gift in memory of his wife.

Under the third arch of the south aisle is Strongbow's tomb, showing a recumbent figure in chain armour ; the half-length effigy beside it in Purbeck marble is said to be that of his son, whom he killed for cowardice in battle. Controversy has been raised over these monuments : that Strongbow was buried in Christchurch, lying *in conspectu*

crucis, we know from ancient records. The monument was broken by the fall of the roof, and restored by Sir Henry Sydney, as the tablet on the south wall relates; and it is possible that the effigy is a sixteenth-century replacement, for the arms on the shield differ from those of Strongbow. The small figure is that of a female in the twelfth-century costume.

The transepts are part of the original building, and an interesting example of the transitional style, from Norman to Early English, in the enclosure of the triforium and clerestory pointed arches within almost semicircular arches, and in the free use of chevron and other mouldings in both. The arches in the north and south walls of the transepts were made at the restoration. The choir and eastern chapels of the original foundation were thrown into one by Archbishop John de St. Paul, in 1857, to form one long choir (102 feet); but Mr. Street restored the whole on the ancient lines. In the chapel of St. Laud is a metal case containing a human heart, said to be that of St. Laurence O'Toole, and a reputed effigy of Basilia, sister of Strongbow. The Lady Chapel in the north-east end, long used as a church by the French refugees in the city, has been converted into chapter-room, school, and library. The crypt is Norman work throughout, and the great strength of the vaulting was shown at the removal of the fourteenth-century choir, when it was found that some of the piers rested not on the crypt piers, but on the arching between. In the sub-chapels are the candlesticks and tabernacles used in the celebration of mass for James II in 1689. The statues of him and Charles II, removed from the old tholsel, the city stocks, numerous monumental remains, and specimens of the old stone-work of the cathedral are also stored here. The vaults were let for liquor and tobacco shops in the sixteenth and down to the end of the next century, which was a cause of great offence to many. The narrow passage (*slype*), now to be seen between the remains of the old chapter-house and the cathedral wall, had its houses, and was called "Hell"; and, by way of contrast to the name, one of the taverns in the crypt was known as "Paradise." Christchurch is





St. PATRICK'S CATHEDRAL, DUBLIN, FROM THE N.E.

(From a photograph by W. Lawrence, Dublin.)

rich in manuscripts : the Black and White Books are kept in the cathedral ; but the great bulk of the documents are now in the Record Office.

St. Patrick's Cathedral. A short walk down Nicholas and St. Patrick's Streets brings the visitor to St. Patrick's Cathedral. The whole area to the north of it was a few years ago a slum of the worst description ; but through the generous, philanthropic spirit of Lord Iveagh, this has been entirely cleared away, artisans' dwellings and the Iveagh House for working men have been erected, St. Patrick's public park has been laid out, and the whole conveyed in trust to the city (Plate XXIII).

Tradition assigns an early church and a well to the site where the cathedral now stands, and in 1901, when excavations were being made, a cross of a ninth or tenth century type was discovered at the spot indicated by Sir Thomas Drew some dozen years before as the site of the well. A church was here at the Anglo-Norman conquest — *Ecclesia St. Patricii in Insula*, so called as it stood between the divided stream of the Poddle river, now confined underground ; and here, outside the city, John Comyn founded his church, and Henry de Loundres raised it to the dignity of a cathedral, intending that it should supersede the older foundation of Christchurch. The church and houses of the clergy were strongly enclosed, the walls having four embattled gates ; but these did not prevent the frequent and successful raids of the Wicklow septs. Within the liberties of the cathedral and St. Sepulchre, the archbishops exercised complete jurisdiction ; but the fortifications and manses have long since disappeared, the library and the old palace of St. Sepulchre, the residence of the archbishops for six centuries, and now a police-barrack, alone remaining. In 1880, a portion of the nave was destroyed by fire, but restored the next year by Archbishop Minot, who also built the massive tower (147 feet), which, it will be noted, is out of square with the cathedral walls ; the spire (101 feet) was built in 1789. The injuries of time and repeated alterations had almost destroyed the original architectural details of the whole building. Great efforts were made by the deans of the

cathedral in the first half of the nineteenth century to prevent the ruin of the structure ; but it was not until 1863 that a complete restoration was undertaken, at the sole cost of Sir Benjamin Lee Guinness. The cathedral is now approached by a fine roadway made at that time. The exterior of the building had suffered so much in the course of time that little of the original details was left. The south-west porch is new ; the west Early English window replaces the restored (1830) perpendicular one, probably of the seventeenth century. The north porch is new, and the north transept rebuilt, which was long used as the parish church of St. Nicholas Without. The organ chamber on the north side of the choir is entered from the east aisle of the north transept by a spiral staircase, designed by Sir Thomas Drew, after the style of one at Mayence ; these were constructed in 1901 at the expense of Lord Iveagh.

The floor of the cathedral lies much below the level of the street, and under it the Poddle runs. The design of St. Patrick's is a perfectly symmetrical Latin cross, 800 feet external measurement in length, and 156 across the transepts. The nave has eight bays, the transepts have three, and the choir has four ; the last has aisles, eastern ambulatory, and lady-chapel of three bays, with aisles and two square-ended chapels. The diversity between the two cathedrals in every respect is great, and shows that they were the work of two distinct schools of builders. The nave and transepts of St. Patrick's are mainly Early English ; the lady-chapel (*circa* 1270) is considered to have been the work of Archbishop Fulk de Saundford, whose effigy is in the north choir aisle. It was carefully restored by Carpenter in 1845 ; it may have been modelled on that of Salisbury, and in its delicacy of design and details may be compared with contemporary work in the Temple Church, London. It was consigned to a congregation of French refugees in 1668 ; and here worship was held by their descendants and other settlers for 150 years.

The work of restoration within the Cathedral included the rebuilding of five bays of the south aisle of the nave and the bays of the original triforium, the south wall of

the south transept, and the whole of the north transept, as already stated ; the clerestory throughout was restored, and the roof of the nave and transepts, being unfit to bear great weight, were girded in lath and plaster ; the octagonal piers of the nave were encased in Caen stone ; the three on the north-west side date from Minot's work of the fourteenth century, and the arches are wider and higher than the remainder, making a break in the string-course, and causing the vaulting shafts to rise from corbels in the triforium, in place of reaching the ground as all the others do. The absence of a reredos, however otherwise it may be missed, gives an uninterrupted and noble view of the choir and lady chapel, and is a distinct feature of this building. The entire cost of Sir Benjamin's work was £150,000. A further restoration was made, in 1900-1, by Lord Iveagh, who, at an expense of £80,000, completely restored the choir and its aisles, including the beautiful stone groining of the roof, and the removal of the organ from the north aisle, revealing beauties in the Early English work unseen and unknown for generations.

The chief interest of the Cathedral to many visitors lies in its connexion with Swift, who held the office of dean for thirty-two years. He and Stella lie buried at the foot of the second column from the west door, on the south side of the nave, marked by a brass-plate. His pulpit is near the south door. Near the door of the robing-room, to the left, is a bust of him by Cunningham ; his own famous epitaph is on a slab near it, and Stella's close by. At the south-west corner is the baptistery with a curious font, and a case containing some ancient charters and other documents ; and against its north wall in the nave is the massive monument of the "Great Earl" of Cork. The cathedral is rich in memorials of all kinds : the north transept has several to the 18th Royal Irish ; the north choir aisle has a tablet with an inscription by Swift to the Duke of Schomberg, styled by Macaulay "a famous libel"—a term it scarcely deserves ; in the lady chapel is a chair used by William III at a thanksgiving service after the victory of the Boyne ; against the south wall is the effigy of Archbishop Tregury (1471), and on the wall of the south choir aisle are four fine brasses—Sir

Henry Wallop (1599), Deputy under Elizabeth; Dean Sutton (1528), Dean Fyche (1587), and Sir Ed. Fitton (1579), President of Connaught and Thomond.

The fine peal of ten bells by Taylor, of Loughborough, was a gift by Lord Iveagh; the old peal by the Purdues of Salisbury (1670) is hung in a lower chamber of the tower. On the south side of the cathedral is Marsh's library, containing about 20,000 volumes and 200 manuscripts; the works are mostly theological, and include Stillingfleet's collection.

The **Cathedral of St. Mary**, generally known as the "Pro-Cathedral," is in Marlborough Street, opposite to Tyrone House. It was built (1816-25), it is said, from a design by an amateur artist in Paris, and is in the prevailing classical style. The front is based on that of the Temple of Theseus, with a hexastyle portico of Portland stone, raised on a platform, and an entablature (which is continued round the sides) and pediment surmounted by figures of the Virgin, St. Patrick, and St. Laurence O'Toole. The sides of the building extend for 160 feet, with a recessed portico in the centre of each, enclosed by a colonnade, and surmounted by figures. The interior consists of nave and aisles, separated by rows of heavy pillars, with an apse at the west end, containing a fine white marble altar by Turnerelli, the roof above which contains a basso-relievo of the Ascension. In the nave are statues of Cardinal Cullen and Archbishop Murray, both by Farrell. Practically all the Roman Catholic churches in Dublin belong to the nineteenth century.

Of the medieval parochial churches, **St. Audoen's**, in Corn Market, is the only one now remaining. It was founded by the Anglo-Normans, and named after St. Owen of Rouen. It consisted of a nave and south aisle and a west end tower, the aisle being a subsequent addition (1481) as a chapel in honour of St. Ann, and a continuation by Fitz Eustace, baron of Portlester (d. 1455). The nave is the only portion now remaining; it opened into the aisle by an arcade of six pointed arches resting on octagonal columns. The west doorway is in the transitional style of

the twelfth century, and the church has a fine Norman font. The Portlester altar-tomb was removed to its present position under the tower, and bears the recumbent effigies of Roland Fitz Eustace and his wife. Here for several centuries were buried many persons eminent in the trade of the city; for the church was once a group of guild chapels, and in the neighbourhood were the halls of many of the Dublin guilds.

St. Werburgh's, near Christchurch, was also an Anglo-Norman foundation, being built by the men of Bristol on the site of an ancient Church of St. Martin, and dedicated, like its sister church of that city, to St. Werburgh, abbess of the convent at Chester, and daughter of Wulfhere, king of Mercia. The church was burned down in the fourteenth century, rebuilt, and was again destroyed by fire in 1784. Five years later it was rebuilt, with a lofty and graceful spire, which, becoming defective, was taken down in 1810. The front is of mixed Ionic and Corinthian orders after the fashion of the prevailing Greek style in Dublin in the eighteenth century. In the vaults lie the remains of Lord Edward FitzGerald, who died of the wounds received at his capture in 1798; and in the graveyard the noted Major Sirr, who arrested him, was buried. In the south wall is a fine sculptured slab of the FitzGerald family. The church was used as a private chapel by the Lord Lieutenant until the Chapel Royal was built, and attracted crowds of fashionable people. It has a very handsome carved pulpit, generally, but we believe wrongly, attributed to Grinling Gibbons.

On the north side of the city, in Church Street, is **St. Michan's**, up to the end of the seventeenth century the only parish church on that side of the Liffey. The present building is a seventeenth-century structure, restored in 1828. The tower has embattled parapets, common to many of the medieval Irish churches, but it too is considered modern. The vaults of St. Michan's have the remarkable quality of preserving the bodies laid in them. The cause of this has been the subject of much controversy; it is due, probably, to the extreme dryness of the air within, owing to the absorbing power of the yellow limestone

of which they are constructed. Several mummified bodies may be seen, among them those of the brothers Sheares, who were executed for high treason in 1798.

A portion of **St. Mary's Abbey** stands off Capel Street. The Abbey was originally a Benedictine foundation, but was given to the Cistercians by Malachy O'Morgair in the twelfth century. It was suppressed by Henry VIII; and nothing now remains but the chapter house with its groined roof and windows. The building is spoiled by a floor seven feet from the ground, and has been long used as a store. It was here that "Silken Thomas" threw off his allegiance, and started the rebellion so unfortunate for him and his house.

St. George's Church, at the head of Temple Street, is one of the finest of the city churches, and was built in 1702, from designs by Francis Johnston. The portico has four fluted Ionic columns supporting an entablature and pediment; behind rises the steeple to a height of 200 feet. Another church of classical design is **St. Stephen's** (1825) in Upper Mount Street, the portico of which is copied from the Temple of Minerva, with its tower surmounted by a dome. The **Church of St. Ann**, Dawson Street, erected at the beginning of the eighteenth century, has a fine Norman front (1869), from a design by Sir Thomas Deane. Of the suburban churches, the richest in design is St. Bartholomew's, Clyde Road, in early English Gothic, by Wyatt. The **Presbyterian Church**, Rutland Square, built (1864) at the expense of Alexander Findlater, is a handsome decorated Gothic building, with a lofty spire (180 feet).

The religious orders have many churches in Dublin. The **Church of St. Francis Xavier** in Gardiner Street is one of the finest in Ireland, and was from designs by T. B. Keane (1832). The plan is cruciform, and its entrance is through a tetrastyle Ionic portico, surmounted by an entablature and pediment. The **Church of St. Saviour** in Dominick Street belongs to the Dominican order, and is a fine example of modern decorated Gothic from designs by J. J. MacCarthy (1858); side-chapels were added to the north aisle in 1895. It has a well-carved façade,

with figures over the doors. Hogan's beautiful *Pietà* is in the face of the altar at the east end of the south aisle. The figure of Christ above is Italian. The Priory is on the north side of the church. The **Carmelite Church** in Clarendon Street dates from 1793, and the transepts were added in 1877. It possesses Hogan's noted piece of sculpture, *The Dead Christ*, which is set in the face of the altar. The **Church of St Andrew** in Westland Row is a cruciform church, built 1832-7, with a central cupola. It has a heavy Doric portico, with entablature and pediment, on the apex of which is a figure of St. Andrew. Above the altar is Hogan's carving of *The Transfiguration*. The **Catholic University Church**, St. Stephen's Green, South, is especially associated with the late Cardinal Newman. It was erected in 1854-6, and is a good example of the Roman basilica type of church; a lady chapel has since been added. It is entered by a Romanesque doorway, and the interior is mixed Byzantine and Italian in style. The **Augustinian Church** in Thomas Street was commenced in 1862, and finished in 1895, from designs by Pugin and Ashlin, and is one of the finest ecclesiastical structures in the city. It has a most striking front, in fourteenth-century French style, rising into a lofty tower 160 feet high, and entered by an elaborately carved doorway. **St. Peter's Church**, Phibsborough, is in the early pointed Gothic style, and belongs to the Vincentian Order. Dating from early in the last century, it has twice been largely rebuilt. The nave and west tower, rising with the spire to a height of 200 feet, are recent, from designs by Ashlin. The transepts, with a fine rose-window in each, are also new, from designs by Goldie, as are also the choir, the apse of seven bays, and a series of chapels off them.

THE ARCHITECTURE OF DUBLIN.

By COUNT PLUNKETT, M.R.I.A.

The qualities of a city's architecture are generally the outcome of trade or of national necessities. Some cities are shaped mainly by their traditions, while others cast off the old, in a fever of progress. Dublin has a rule to itself. With few manufactures, and only irregular employment for many thousands of its artisan population, it is subject to rapid changes in its aspect. Its large leisured class of citizens, of a moderate but fixed income, might be supposed to resist novelties, which indeed result largely from the decay of our country towns, and consequent centralization in the capital.

Since old cities commonly illustrate the growth, development, and vicissitudes of a people, we can read in their streets many chapters of a country's history. Though this general proposition applies indifferently to Dublin, our city still retains some interesting examples of architecture dating from an age of luxury and public spirit.

The natural conditions which affected its foundation continue to exercise a strong influence on the preservation, expansion, and sanitation of Dublin. The site of the city was an irregular slope towards the river and the sea, diversified with small hills. Among the drawbacks of its position were the low-lying stretches of land within the city, and the expanse of sand through which the river meandered. Towards the river ran several water-courses, and even on the hillocks were many springs, and some undrained bogs. Several rivulets still run under the city. Like many of the English cathedrals, Christ-church and St. Patrick's were built on morasses, which continue to menace these ancient buildings. The Dublin Mountains, on the south, with their wooded slopes, reflect some beauty on the city; but the low-lying sea-shore that touches it has been of necessity a neglected foil to the city's architecture.

Indeed, the old plan of the city remains practically

unaltered. The principal thoroughfares, though more or less direct, are not so straight in line as to sacrifice variety. We have few streets of any length that are absolutely straight. Westmoreland Street and D'Olier Street diverge from the line of Sackville Street. Thoroughfares like Grafton Street, though short, and altered in recent times, and South Great George's Street, congested with business, are as winding as neglected back streets. The building of a city market, and the running of tram-lines, make little change in the width and general plan of a Dublin street, owing to the penal cost of promoting Improvement Bills in the Imperial Parliament. One of the greatest of our thoroughfares, Capel Street, though it has lost all its old-time quaintness, is as narrow as it was a hundred years ago; and Parliament Street, which continues it on the south side of the river, cramps the view of the City Hall. The Wide-street Commissioners in the eighteenth century made some bold changes, and planned reforms that are still called for.

Many of our modern buildings suffer greatly from the want of "distance," caused mainly by the narrowness of the streets. While a house like that of the Royal Irish Academy, in Dawson Street, can be fairly seen, its neighbour, the Church of St. Ann, loses in dignity and effect by the nearness to the eye.

The most extended roadway in the residential quarter is that beginning at the east side of Merrion Square, and running in a straight line to Leeson Street. Owing to the irregular rise of the ground, the varying heights of the red-brick buildings, and the pleasant breaks made in the course by green squares and cross-streets, this affords one of the prettiest and most reposeful views in the city.

One may roughly group the leading institutions in the city. On the south side of the river are the venerable Cathedrals, the Universities, the Castle, and the principal Banks, and on the north the Four Courts, Custom House, Post Office, King's Inns, Rotunda, and many fine churches.

College Green may be looked on as the centre of the city, and (apart from the Cathedral area) the most interesting quarter in it. Few, if any, of the world's

capitals can show—in a little space, and in like admirable contrast—buildings so full of classic feeling, and so popular in their appeal.

The **Parliament House** (now the Bank of Ireland) underwent many changes (Pl. XXIV). It is erected on the site of Chichester House; the main building was carried out under the supervision of Sir E. Lovat Pearce, about 1789, from the plans (it is thought) of Cassels, who designed Leinster House. In 1785 James Gandon was commissioned to enlarge the east side; to bring the Lords' Portico to the street-level, he used Corinthian columns, with an Ionic entablature to match the rest of the building. In 1792–4, more space being required by the Commons, the West Portico (to balance the eastern, but Ionic) was added, with a screen wall and Ionic colonnade connecting the old House and the wings—improvements attributed to Robert Parkes. After the Union, the Bank made some external additions from the plans of Francis Johnston, erecting the great gateways in Foster Place and Westmoreland Street, and altering the positions of the entrances; and within, while the House of Lords is unchanged, no trace of the Court of Requests or of the Commons remains. The statues—Hibernia on the central apex, Fidelity on her right, Commerce on her left, and Fortitude, Justice, and Liberty over the pediment of the East Portico—were the work of Edward Smith, an Irish sculptor. The Royal Arms in the tympanum were modelled by Flaxman.

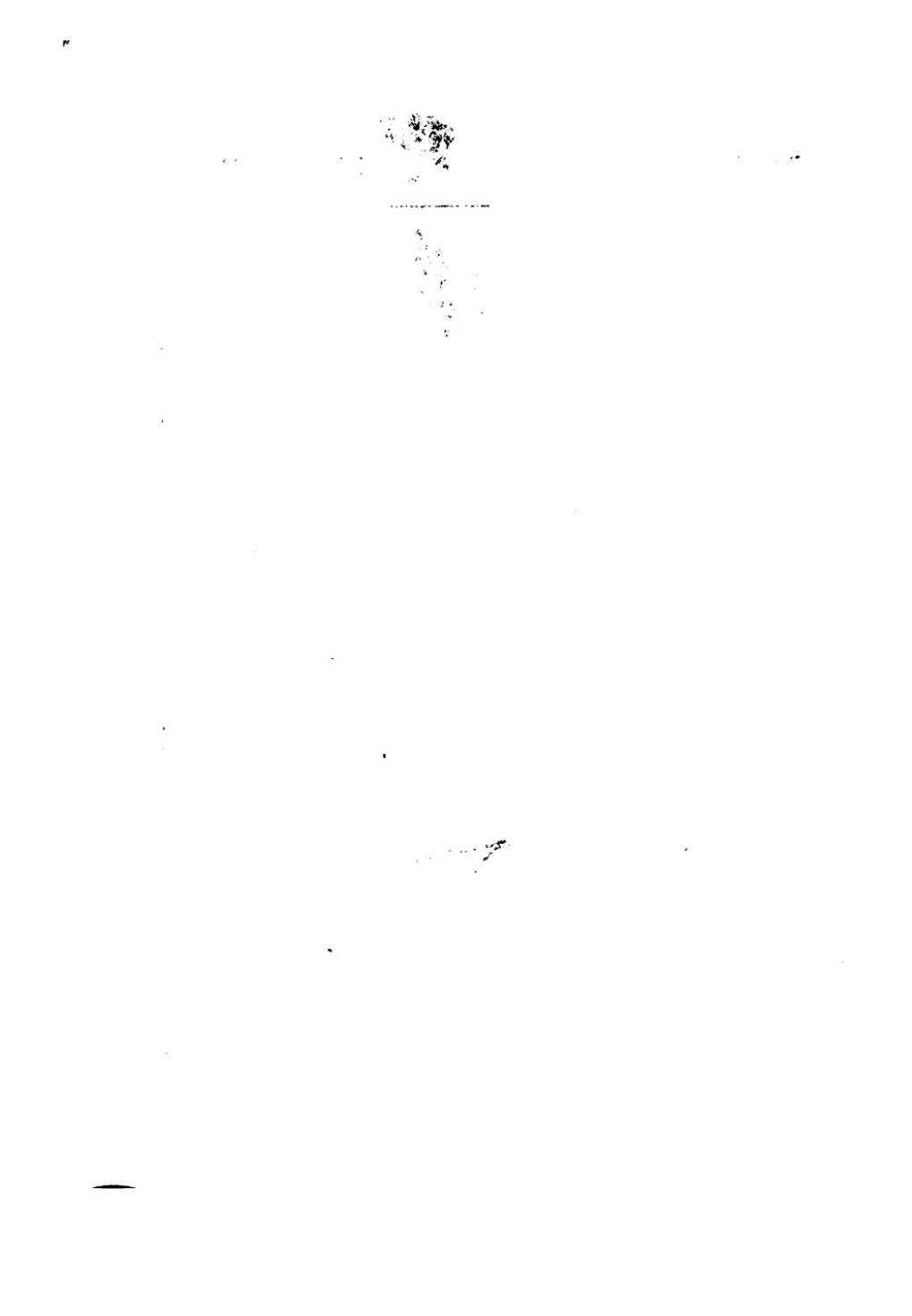
The general effect of the Parliament House, with its "confusion" of styles, is singularly beautiful and noble. It took genius to devise those great sweeping curves of the wings, to lighten the expanse of the screens with Ionic columns, to make the wide exposed portico solemn with massive Corinthian. The Parliament House covers an acre and a half with its semicircle. One of the purposes suggesting the employment of Corinthian columns on the Lords' entrance was the harmonizing of the House with Trinity College.

The front of **Trinity College** (Plate XXV), re-facing the Elizabethan building, was built in 1759, principally at the



COLLEGE GREEN, DUBLIN, WITH THE PARLIAMENT HOUSE (NOW BANK OF IRELAND), IN 1791.

(From Malton's view.)







TRINITY COLLEGE, DUBLIN, IN 1791.
(From Malton's view.)

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cost of the Irish Parliament, from the designs of Sir William Chambers. It is fortress-like and impressive, and in great contrast to its beautiful neighbour. The quadrangle contains its earliest buildings. The Library, overlooking the quadrangle, was built in 1782; at that time it was accounted one of the principal libraries in Europe. It is an imposing building of cut stone; formerly there were cloisters at the north and south sides, but, the space being required by readers, the arches were filled in. The Library proper is on the second story, and contains 300,000 volumes; formerly this hall had a flat ceiling, but now is open to the arched roof. This improvement was devised by Sir Thomas Drew. On the further side of the quadrangle is the Chapel, insignificant externally, but containing some good wood-carving. The Dining Hall, attributed to Cassels, is interesting and peculiar; it has a fine fireplace and panelled walls.

Adjoining the Library is the Examination Hall, a very lofty and beautiful room rather daintily decorated, and containing the remarkable monument of Dr. Baldwin by Hewitson, an Irish sculptor. This Hall and the Chapel were designed by Chambers and executed by Meyers. Facing the Library is the new Graduates' Memorial Building, occupied by the College Societies; and the east end of the quadrangle is closed by a terrace of Queen Anne houses (Sterling's Buildings), now unhappily modernized. In a further square is a little Doric Temple, the Printing Office of the University Press; and opposite this are the New Buildings, mainly used by the Engineering School—a Romanesque structure, by Woodward and Deane, with a great hall that is almost Byzantine. The string-courses and other projecting ornaments are elaborately carved; and the *ensemble* and detail of the work won the enthusiastic admiration of Ruskin.

In the quadrangle there is a graceful, and rather modern-looking Campanile, built in 1852. Its centre is said to mark the crossing of the old monastic church of All Hallows; the cloisters are supposed to have extended to what is now the Provost's garden, and to have suggested the open treatment of the Library corridors.

To the right of Trinity College is the **Provost's House**, a rather solemn dwelling (a duplicate of that of the famous General Wade, in Piccadilly, which is now altered beyond recognition).

COLLEGE GREEN, a banking quarter, contains many fine modern buildings. In the older Dame Street are the Commercial Buildings in Irish granite, designed by Waldre about a century ago. Further up, on the slope of Cork Hill, is the **City Hall**, originally the Royal Exchange (Plate XXVI). It is evident that this

“ far-withdrawing line
Of palace fronts Palladian ”

should have been made visible from Dame Street. From the height on which it stands, its splendid Corinthian front, and the great dome above it, were meant to dominate the City. A fairly good view of it is obtainable from Parliament Street; and it is observable to some effect from Capel Street, now that the old Essex Bridge is removed. Formerly the colossal statue of O'Connell, by John Hogan, stood in front of the porch, but it is now in the circular hall, under the lantern and flanked by other statues. The Council Chamber, a comparatively small hall, is reached by a narrow staircase, for the building was designed for beauty rather than for convenience. It is the work of Thomas Cooley (1769), who succeeded in a competition with Sandby and Gandon. Some injury is done to the effect of the building by recent changes; the steps were originally designed to be stylobate.

The adjoining **Municipal Buildings**, in cut stone, also do credit to the eighteenth century. Beside them a new avenue, Lord Edward Street, was made about twenty years ago, to lead directly to Christ Church.

The charm of the Dublin streets was greatly added to by the beautiful curves of our old stone bridges, of which only a couple remain; they rose too steeply for the convenience of traffic. One bridge of a later date, the Wellington—or, as it is generally called, “the Rialto”—a slim iron foot-way—arches its delicate lines against the sunset, and brings a needed grace to the river.

PLATE XXVI.

[To face page 314.



THE ROYAL EXCHANGE (NOW THE CITY HALL), DUBLIN, IN 1791.

(From Malton's view.)





PLATE XXVII.

[*To face page 315.*



THE CUSTOM HOUSE, DUBLIN, IN 1791.
(From Malton's view.)

The old Custom House, built in 1707, far up the river, adjoining Essex Bridge, was, by the middle of the eighteenth century, found to be too remote from the docks, and otherwise unsuited for its purpose. Through the influence of the Rt. Hon. John Beresford, the new **Custom House** (Plate XXVII) was commenced in 1781, and completed in 1791. With the quays and docks, it is said to have cost half a million pounds ; the great building is now used mainly for tax-offices. The Custom House can hardly be seen to good effect, as the view of it is obscured from the river-entrance and from O'Connell Bridge by the Loop Line Railway. It was planned on a scale that seems quite out of proportion to the business of the city, for it is 375 feet long by 205 feet deep. It has four fronts, being chiefly Doric in style. Open arcades lighten the effect of the building on the river-front, and it is decorated with much beautiful carving and many allegorical statues. The lantern, with its slim pillars, crowned by a small dome, gives an unusual grace to the building.

Some distance up the river are the **Four Courts**, as they are called, begun in 1776, by Cooley, and completed, after his death, by Gandon in 1797. This building has the impressive quality aimed at by the architects of the period. The great portico, with its six Corinthian columns, and the large and lofty dome behind it, require the wings and the carved stone entrances to the court-yard to justify their proportions. The pediment is surmounted by the statues of Moses, Justice, and Mercy. The decorative effect of the building is very fine ; the visitor is, however, greatly disappointed at the meagre accommodation of the interior. The round hall, which is of remarkable beauty, contains a few statues of eminent public men. The fine quays are here fenced with graceful balustrades.

A little further up, on the southern side of the river, stands **Moira House**—that famous palatial building, where, in an octagon room decorated with mother-of-pearl, John Wesley met Lady Moira. It is now transformed into a dismal institution for mendicants.

Of the main thoroughfares, the most noteworthy is **SACKVILLE STREET**, which extends from Foley's beautiful

O'Connell Monument to the Rotunda. Unluckily, Nelson's Pillar, a bold Doric column of granite, 110 feet in height, breaks the vista midway, and effectually obstructs the traffic. The Pillar likewise spoils the effect of the adjoining **General Post Office**, a classical nineteenth-century building designed by Johnston.

The **Rotunda Hospital**, founded by Dr. Mosse, was opened in 1745, being, it is said, the first maternity hospital in the British dominions. It was built by Cassels; the charming little chapel is attributed to Gandon. Pretty colonnades connect the main building with the wings. To its right is the **Rotunda**, a lofty round hall, built in 1755, from the designs of Richard Johnson. It is charmingly decorated within and without; the exterior frieze of draped ox-skulls in white pottery is the work of Flaxman. This hall is famous as one of the meeting-places of the Irish Volunteers of 1782; for over a century it was used as an Assembly Room, for the benefit of the Hospital, and it is still in use.

The ancient **Cathedrals** still draw us with the fascination of their history, in spite of changes and restorations. Their principal features, however, have been dealt with in a previous section (p. 299).

In Nos. 6 and 7, Christchurch Place, adjoining Christchurch Cathedral, there are remains of the oak beams of the **Carbrie House**, the last of our wattled dwellings, demolished in 1780.

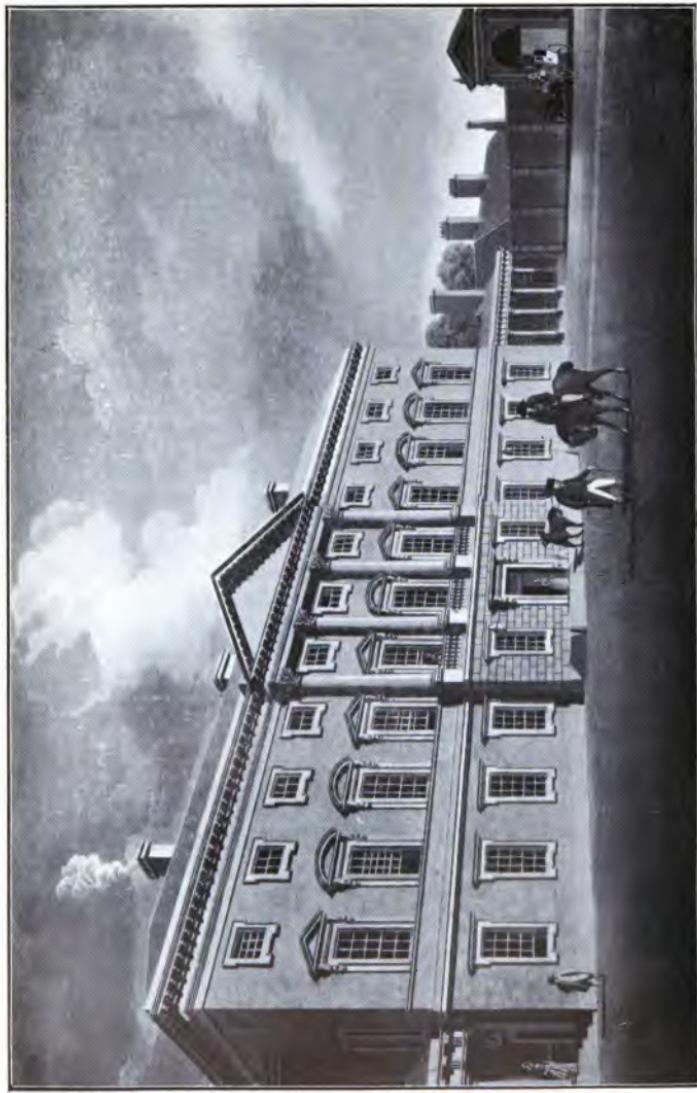
Near St. Patrick's Cathedral is **Marsh's Library**, a quaint little treasury of sixteenth- and seventeenth-century books.

The interest of **Dublin Castle** is due to its history rather than its beauty. The Lower Castle Yard, though flanked on one side by Johnston's Castle Chapel (in modern "Gothic"), is rather unattractive. The only ancient building visible from the Yard is the great round (twelfth-century) Bermingham Tower, which is entered from the roadway to Ship Street, and which seems incongruous in its latter-day surroundings. The Upper Castle Yard is more in harmony, having two handsome gateways (one disused), and the picturesque Queen Anne Bedford Tower,



PLATE XXVIII.

[*To face page 317.*



LEINSTER HOUSE, DUBLIN, IN 1791.
(From Malton's view.)



with its very fine cupola, and its open gallery for musicians. The Castle contains some well proportioned rooms, with florid modelling in plaster. St. Patrick's Hall, which is 82 feet long and 41 feet broad, and nearly 40 feet in height, was decorated for the Knights of St. Patrick in 1788. Its great ceiling-paintings by Waldre, the architect, are of some merit. This Hall was very tastefully coloured and gilt about five years ago.

Many of the most important public bodies and institutions in Dublin are housed in eighteenth-century dwellings, formerly the "town-houses" of members of the Irish Parliament.

Leinster House (Plate XXVIII), the residence of the Dukes of Leinster, in Kildare Street, was built by Cassels about the year 1745; it was for a while the home of Lord Edward FitzGerald. It is a massive and dignified structure, more beautiful within than without. The large, finely proportioned reading-room, on the first floor, has an Adams ceiling which is a triumph of exquisite workmanship. This house was acquired by the Royal Dublin Society, which occupies it; here also are the offices of the National Museum of Science and Art.

The adjoining modern classical renaissance building, to the right, is the **National Museum**; and facing it is the **National Library of Ireland**. These buildings, designed by the late Sir Thomas Deane, are handsome and decorative examples of their style.

The native exhibits in the Museum include models of "Irish Romanesque" architecture, and of the greater Irish crosses; of statuary by modern Irish artists; also some interesting examples of craftsmanship from Dublin interiors of the seventeenth and eighteenth centuries. Here also is deposited the great treasury of Celtic arts, the collection of the Royal Irish Academy.

A large wing of the Museum (containing the Natural History Collection) extends through Leinster Lawn to Merrion Square. On the opposite side of the Lawn is the **National Gallery**, notable for its Old Masters and Irish portraits.

Of the private dwelling-houses whose merits have stood

the test of time, the most distinctive in the city is **Powerscourt House**, in William Street, built for Lord Powerscourt in 1771-4 by Robert Mack, from the designs of Cassels (?). The work, executed in granite from the Powerscourt quarries, has remarkable dignity and grace of line. The curious square structure over the pediment was intended for an observatory. This lovely building is now a warehouse.

The first Earl of Charlemont returned home, after a long sojourn in Italy, with a taste for classical architecture. He gave a commission to Sir William Chambers, whose fine fancy produced a little square casino, a Doric temple with four porticoes, which glimmers in white marble in the wooded grounds at **Marino** (Clontarf).

In St. STEPHEN'S GREEN there are several interesting houses. For instance, the **Loreto Convent** (Grattan's house), on the east side, and the house of Richard Whaley, now **University College**, on the south (see p. 836). The latter contains a great deal of elaborate stucco-work, which is altogether inferior to the ornament in another Jesuit College, Belvedere, north of the city. In ELY PLACE, adjoining the Green, there are two houses, the Valuation Offices, which contain work of much delicacy. Some of the earliest and most beautiful stucco and carved work in Dublin is to be found in 10 Henrietta Street, which belonged to the Countess of Blessington. Near by is the **King's Inns** (designed by Gandon, who is supposed to have also planned Charlemont House in Rutland Square).

Among the more modern buildings of merit are the **Royal College of Surgeons** (1809), on St. Stephen's Green, and the **Royal College of Physicians**, in Kildare Street.

Dublin possesses some thirty large and well-conducted hospitals. The **Royal Hospital** for Disabled Soldiers at Kilmainham is one of the oldest buildings on the city's border. The Duke of Ormond laid its foundation in 1680; and it was completed in four years. Standing amidst beautiful grounds, it covers a square of 250 feet, round a courtyard, and presents four fronts. The splendid dining-hall, 100 feet long by 50 feet wide, contains some interesting

historical portraits, and the chapel is ornate with wood-carvings.

A distant view of Dublin in the eighteenth century showed the city apparently spireless; and the first church of modern times with a spire of considerable elevation was St. George's (in Temple Street), built by Johnston at the beginning of the nineteenth century. To-day the city's prospect is punctuated by spires of no little beauty, for its churches are many, and mostly Gothic.

Those who planned the city—while it was still in the making—had to consider the general perspective, and to calculate on the peculiar aerial effects of a climate almost moist. Their success in building according to their environment is strikingly illustrated by Malton (see p. 325), who has recorded the impressionism of our streets with absolute fidelity. In certain streets, such as Upper Fitzwilliam Street, the sky-line leads the eye directly to the Dublin Mountains, which, far from being dwarfed by their distance, loom up in the magnifying Irish atmosphere. Chromatic colouring was a thing not dreamt of by our old architects, but they had mellow-tinted bricks, and they frequently used cut stone up to the first floor.

Though a flatness of façade was the rule in private houses, many of the shops were saved from monotony of appearance by rounded fronts and the most elaborate "leading"; and entablatures decorated with tenuous festoons were until lately to be seen in some of our back streets.

Irish architecture is generally reposeful; and our Queen Anne work seldom ran into the eccentricities common to the style.

An ancient city, Dublin has no corbelled or timbered houses, and few gables. Most of its landmarks have disappeared. It has no gates; part of the old "Dame's Gate" was turned to use for the pedestal of the statue of William III in College Green; and the castellated gate built by Johnston in 1812 was removed, in 1846, from Barrack Bridge to the Hospital at Kilmainham.

Some thirty years ago there were in the Coombe and neighbouring quarters many quaint structures of the close

of the seventeenth century. Now the type of house with Dutch gable, and sashes flush with the wall, is only a memory. Little of Queen Anne work remains. About 1776 extensive changes began in the city—streets were opened in all directions, and the building mania lasted for nigh fifteen years. The style of architecture then common tried the gifts of the designer rather severely. The houses of this period stretch monotonously in a straight line through many of our most fashionable districts. They have suffered greatly from modernization, and the consequent sacrifice of effects relied on by the architects. The cross-line of small-paned sashes and the graceful scrolls of fan-lights are gone, leaving vacant spaces; of the striking link- and lamp-holders, and other fine iron work, there is hardly a trace. Many of the balconies have been removed, to be sometimes replaced by the pretentious castings of the fifties. It is only in architectural detail that we discover the finer qualities of the earlier time—in the beautiful proportions of doors, windows, and porticoes. The sense of beauty, however, found free play in the interiors—in their noble spaciousness, worthily balanced by the quality of the workmanship in stucco and joinery and carving and inlaying, which made the seventeenth-century Dublin house one of the most artistic of European dwellings.



FIG. 41.—Parliament House in flames.
Gentleman's Magazine, 1792.

OLD DUBLIN, AS REPRESENTED IN
ENGRAVINGS.

BY E. MACDOWELL COSGRAVE, M.D.

Old engravings of Dublin are of interest, as they enable us to reconstruct places and buildings at various dates, and to study the steps of the physical evolution of the city.

They illustrate also the appearance of the inhabitants, their dresses and many peculiar customs; and if the more fugitive caricatures and "penny plain and twopence coloured" sheets are included, a more intimate knowledge of the inner life of our forefathers is gained; so that we get, as it were, flashlight-peeps at their aspirations, their prejudices, and their quarrels.

The description of a picture conveys but little, and there is here room to illustrate only a few examples. Those interested in the subject are accordingly recommended to visit the excellent and well-arranged collection of engravings of Dublin, which is shown in one of the rooms of our National Gallery. In the space at my command it would be impossible, even if desirable, to attempt to give a catalogue of engravings of Dublin, such as has already appeared in the Journal of the Royal Society of Antiquaries of Ireland.¹ All that can be done here is to call attention to the finer sets of pictures and to the more interesting individual examples.

It is unfortunate that hardly any pictures of Dublin anterior to the eighteenth century are known, as up to that period Dublin had not spread with any freedom outside its walls, and had preserved many medieval features, illustrations of which would have been of historic value.

The two earliest pictures of any importance are illustrations to John Derrick's "The Image of Ireland," 1581. They show Sir Henry Sydney, Lord Deputy for Queen Elizabeth, leaving Dublin to chastise the rebels and return-

¹ Journal of the Royal Society of Antiquaries of Ireland, vol. xxxv., pp. 95, 363; vol. xxxvi., p. 400; vol. xxxvii., p. 41.

ing victorious, and give interesting peeps of the walled city. The eighteenth century is well illustrated. Brooking's map, 1728, engraved by J. Bowles, is a fine engraving, measuring 28 inches high, 55 inches wide. Its centre is occupied by a good map of the city, over which is a view



FIG. 42.—Front of Trinity College. *Brooking, 1728.*

of the city from the north, so arranged that each building is over its place on the map. The two wings contain twenty views of the principal buildings. Three of those, which have since vanished, are here figured, viz.: fig. 42, *Front of the College*; fig. 43, *The Tholsel*; fig. 44, *The Custom House*.



FIG. 43.—The Tholsel. *Brooking, 1728.*



FIG. 44.—Custom House.
Brooking, 1728.

The cathedrals, which were omitted by Brooking, are illustrated in Harris's edition of Sir James Ware's works in 1789. Fig. 45 shows the view of St. Patrick's Cathedral as it appeared before the spire was added to Minot's fine tower. The cathedrals are also engraved in Harris's History of Dublin, 1766, and in Grose's Antiquities, 1792.

The first important series of engravings of Dublin appeared in 1758. They were from six drawings by Joseph Tudor (ob. 1759), and the names are given both in English



FIG. 45.—St. Patrick's Cathedral. *Ware*, 1739.

and in French. They were issued, with slight alterations, by three publishers, but it is not easy now to secure a full set. They represent: 1, *Dublin from the Magazine Hill*, one of the most frequently copied of Dublin engravings; 2, *Barracks*; 3, *Castle*; 4, *Custom House*; 5, *Parliament House* (fig. 46); and 6, *Library, Trinity College*—chiefly interesting as affording the only view of some of the Elizabethan buildings.

A rare engraving appeared in 1756; it shows *Sackville*

Street and Gardiner's Mall (fig. 47); the uniformity of the houses, and the central walk protected by walls and obelisks, are strangely lost in the Upper Sackville Street of to-day.

In 1762 magazine-illustrations of Dublin buildings began in Peter Wilson's *Dublin Magazine*, the first six being drawn by John Aheron, the author of a rare treatise on architecture. Walker's *Hibernian Magazine*, Exshaw's *Gentleman's and London Magazine*, and the *Gentleman's Magazine* (London), issued a large number of Dublin views in the last quarter of the century (fig. 41).



FIG. 46.—College Green and Parliament House. *Tudor*, 1752.

In 1767 a set of five fine views of the Houses of Parliament, drawn by R. Omer, was published by Bernard Scalé.

In 1766 Harris's History of Dublin appeared with ten plates, some of which were copied from Brooking (1728); and in 1780 Pool and Cash published their book containing twenty-nine accurately-drawn plates.

In 1783 a series of small engravings from drawings by Wheatley and Barralet was published by John Milton, in his *Views of Seats, &c.*

In 1784 the well-known engraving of Wheatley's picture of the *Volunteers in College Green* was published; it is still frequently met with. In 1780 Wheatley painted a fine interior of the House of Commons, showing Grattan moving the claim of Irish Rights. This was published—photogravure—for the first time in 1907.

In 1784 a very rare series of aquatints, bearing only the date and the address, "15 Leicester Fields," was published. Nine of the series are in the possession of the writer; one showing the Irish Volunteers in College Green (fig. 48) hangs in the National Gallery, near Wheatley's large picture of the same subject.



FIG. 47.—Sackville Street and Gardiner's Mall, 1756.

The eighteenth century closed with the appearance of Malton's views (Plates XXIV–XXVIII), the best-known and finest series of pictures of Dublin; the twenty-five plates appeared in 1791–9, and are large and boldly drawn. Several altered and re-engraved plates are sought by collectors. Sets, both plain and coloured, are often sold, and command good prices. Malton's plates give an excellent idea of Dublin as it appeared in its period of greatest magnificence. During the same period La Porte

issued some half-dozen larger views of the neighbourhood of Dublin that are of considerable merit.

The nineteenth century opened badly ; political unrest and financial weakness were its key-notes, so that art did not get much encouragement ; and even in 1818, when Whitelaw, Warburton, and Walsh's ponderous *History of the City* appeared, most of the illustrations were unacknowledged copies of Malton, no effort being made to bring them up to date.

Good work, however, was done between 1818 and 1818,



FIG. 48.—Volunteers in College Green, 1784.

when T. S. Roberts, a Dublin landscape-painter, issued several large coloured views.

Brocas, in 1818–1829, issued his well-known set of twelve views, which do for this period what Malton did for his. The buildings and people are spiritedly sketched in, and the series is a valuable record.

Some of the most interesting work of the earlier part of the century are the etchings from the drawings of the well-known archæologist, George Petrie. Petrie was prolific, accurate, and artistic, and some fifty of his drawings are reproduced in Wright's *Dublin, Cromwell's Tours*, and

Dublin Delineated. The original sketches from Wright's *Dublin* hang in the Royal Irish Academy House (fig. 49).

George IV's visit in 1821 led to the appearance of a large number of views, of which the reception of the King in Sackville Street, and his departure from Kingstown, are the best known. But these illustrations are poor in comparison with older work, and mark the decadence of the large coloured view.

From 1820 lithographs were issued, and numerous copies of older pictures appeared. Soon after 1830 woodcuts began to oust copper etchings, the possibility of printing with type making up for their deplorable quality; later on woodcuts improved and flourished, until in turn process-work displaced them.



FIG. 49.—Barrack and Queen's Bridges.
Petrie, 1819.

The introduction of railways and the Great Exhibition of 1851 led to other special outputs.

Many other classes of pictures reward both the collector and the student. The coloured caricatures and fugitive prints, so popular at the end of the eighteenth and in the early years of the nineteenth century, show street-scenes and buildings, costumes (fig. 50), and portraits. Local events of the latter half of the century, and the additions and alterations to public buildings, can be followed in the pages of the *Illustrated London News* and other weeklies. But whilst these help to make the picture-story more complete, the era of fine pictures, of pictures which will be prized by collectors, is undoubtedly

the latter half of [the eighteenth and the] first third of the nineteenth centuries.

Those who wish to make a representative and choice collection should aim at securing full sets of good impressions of Tudor (1758), Malton (1791-99), and Brocas (1818-29).



FIG. 50.—*Taste à la mode.* Rotunda Gardens. Coloured print, 1790.

MAPS OF DUBLIN.

The earliest plan of Dublin is dated 1610. It appears in the corner of the map of Leinster in Speed's "Prospect of the World." A contemporary copy occurs in Braun and Hogenberg's Geography. Speed's map was reissued in 1676, with no printing on the back. This map shows how little the city had spread outside its walls, except about St. Michan's Church to the north of Old Bridge (fig. 51).

T. Phillips' map, 1685, is carefully done. L. R. Strangways published *An Attempt to Identify the Streets as Depicted by T. Phillips*, 1685, in 1904.

Collins' map, 1686, of the Bay of Dublin, gives an interesting plan of the city.

Mill's map, 1714, shows the water approaches to the city, the deepest channel skirting the College grounds, close to the site of Westland Row.

Brooking's magnificent map of 1728, already alluded to, comes next. It shows the city as it was before its great expansion in the latter half of the eighteenth century.



FIG. 51.—Speed's Map of Dublin, 1610.

John Rocque issued several maps. The first, a plan of the city and its environs, on a single sheet (20 $\frac{1}{2}$ in. by 30in.), appeared in 1754 (?); it was engraved by J. J. Perret. A copy of this, engraved by A. Dury and P. Halpin, appeared in 1757. B. Scalé also engraved copies.

Rocque's four-sheet map, engraved by A. Dury, appeared in 1756, and was reissued, with additions and improvements, by B. Scalé in 1778.

Cook's Royal map (issued in connexion with George IV's visit) appeared in 1822, with twenty-five views on the margin. It was reissued in 1831.

Heffernan brought out maps in 1861 and 1868. The former had thirty-six views, and the latter twenty-two.

Maps have been issued with the Dublin Directories from 1778 onwards.

Ordnance Survey maps were issued from 1887, and were revised in 1864 and 1887.

GAELIC PLACE-NAMES IN THE DUBLIN DISTRICT.

BY E. FOURNIER D'ALBE, B.S.C., M.R.I.A.

As in all parts of Ireland, the majority of place-names in and around Dublin are of Gaelic origin. A few Norse names remain to bear witness to the period of Norse rule which gave Dublin its first claim to distinction. To these belong such names as Howth, Dalkey, Lambay, Leixlip (Salmon's Leap), and Oxmantown (Ostmen's Town). But these are exceptions to the general rule, and both the modern names of Dublin are pure Gaelic. One of these, Dublin, Irish *Dubh-linn* (*Duibh-linn*), means Black Pool, and is strictly equivalent to the Welsh *Dulyn*, which means the same. The "pool" was formed by the lower tidal reaches of the River Liffey. The other native name for Dublin, and the name by which it is generally known in the Irish-speaking districts of Ulster, Connaught, and Munster, is *baile Átha Cliat* (Baile Atha Cliath, pronounced Bla-cleea), and means "The Town of the Ford of Hurdles." The main road from Tara, the seat of central government, to Wicklow crossed the Liffey at what is now Bridgefoot Street, by a ford which was marked by hurdles.

The interpretation of Gaelic place-names is facilitated

by the constant recurrence of certain elements such as Ard (árd, a height), Bally (baile, a town), Boher (bóthar, a road), Caher (caiseal, a city), Carrig (carrach, a rock), Cashel (casadh, a circular stone fort), Clon (cluain, a bog-island), Clough (cloch, a stone), Coomb (cúim, a hollow, a vale), Derry (doire, an oak wood), Drum (druim, a ridge), Dun (dún, a fort), Gall (gall, a foreigner), Glen (gleann, a glen), Inish (inis, an island), Inver (inbeag, a river-mouth, an estuary), Iska (uisce, water), Kil (cill, a church), Knock (cnoc, a hill), Lis (lios, an enclosed fort), Lough (loch, a lake), Lug (luig, a mountain hollow), Maghera (maighre, a plain), More (móir, great), Moy (maigh, a plain), Moyle, Meel (maol, bald, unwooded), Muck (muc, a pig), Rath (ráth, an earthen fort), Rinn (rinn, a point of land), Ross (ros, a headland), Shan (sean, old), Skeagh (rgeac, a whitethorn), Slieve (sliab, a mountain), Tee (teig, a house), and Tubber (tobar, a well).

Among the more important Gaelic place-names about Dublin are the following :—

Clontarf (cluain tarbh, bull meadow).

"Phoenix" (fionn-uisce, limpid water).

Kilmarnham (Cill Maighneann, St. Magnen's Church).

Chapelizod (Seipéal Íosóilse, Isolde's Chapel).

Glendalough (gleann dá loch, glen of two lakes).

Naas (náir, a meeting-place, formerly the capital of Leinster).

Poulaphuca (poll an púca, the hole of the pooka, or goblin).

Enniskerry (áth na rgaibhe, the ford of the stony crossing).

Scalp (rgealp, a chasm).

Stillorgan ('r Tígh Lorgáin, (in) Lorgan's House).

Dundrum (dún druma, ridge-fort).

Killiney (? Cill Ingean Leinín, the Church of the daughters of Leinin).

- Ballybrack (*baile bpeac*, speckled town).
- Terenure (*cip an iubair*, land of the yew).
- Glenageary (? *gleann an gaoirtai*, a wooded glen).
- Raheny (*ráit Éanna*, Enna's rath).
- Malahide (*mullaé Íde*, Ida's summit).
- Balbriggan (*baile bpeacán*, Breca's town).
- Drogheda (*droichead átha*, the bridge of the ford).

The Dublin and Wicklow Mountains bear chiefly Gaelic names. Thus we have—

- Kippure (*cip iubair*, a yew-stick).
- Tonduff (*cóin duib*, a black bottom).
- Douce (*beann Dámhúir*, peak of Damhus).
- Carrignagunneen (*carrat ag na gcoinnín*, rabbit's rock).
- Lugduff (*luig duib*, black hollow).
- Lugnaquilla (*luig na coille*, hollow of the wood).

The practice of giving both the Irish and English names on name-plates and sign-posts in the Dublin district was begun in 1898, and has been greatly extended since then. Several stations on the Dublin and South-Eastern Railway have their Irish names prominently displayed, notably that of Dalkey, where the old name *Oeilgínir* (thorn island) is seen in large letters on the embankment. Within the area controlled by the Dublin Corporation all name-plates and sign-posts will within a few years become bilingual, the practice being to make all new plates and renewals of old plates bear the names in both Irish and English. The Irish equivalents are furnished by a special Reference Committee appointed by the Celtic Association, the Gaelic League, and the Society for the Preservation of the Irish Language.

EDUCATION AND RESEARCH.

GENERAL EDUCATIONAL INSTITUTIONS.

BY JOHN COOKE, M.A., M.R.I.A.

Dublin University ; Trinity College (Plate XXV). Several attempts were made to found a university in Dublin before the sixteenth century. Owing to the action of the mayor and corporation of the city in petitioning the Privy Council of England through Henry Ussher, a warrant was granted by Queen Elizabeth ; and the foundation of Trinity College was laid in 1591, on the lands of the priory of All Hallows, suppressed by Henry VIII, but bestowed by him on the Dublin corporation, to be granted by them in turn for the site of the new university. Much of the land was then a marshy waste ; but it has now become a valuable property, worth £10,000 a year. Lord Burleigh was the first chancellor, and Adam Loftus, archbishop of Dublin, the first provost of the new institution. The income of the college at first was the small sum of £800 ; successive grants were made by the Queen and James I, and the buildings grew in the course of time. It suffered in the rebellion of 1641 ; and James II pursued the same policy towards Dublin that he pursued towards the English universities ; and on the refusal of the governing body to admit a Roman Catholic to a Fellowship, £400 a year was taken from them. The college was taken for a garrison in 1689, and the chapel used as a store for gunpowder. Dr. Moore, a Roman Catholic, was appointed provost. He did much to preserve the institution during his short tenure of office, and alleviate the condition of the Protestants imprisoned within its walls. The battle of the Boyne sealed the fate of James II ; the banished Fellows returned, and the college resumed its usual course. In 1698 the centenary of the foundation of the university was celebrated with much state and ceremony, and the poet laureate, Nahum

Tate, being a graduate, contributed an ode for the occasion. Provost Baldwin bequeathed some £75,000 to the university; and his munificence is fittingly commemorated by a monument in the examination-hall. To his successor, provost Andrews, the university owes still more; for it was chiefly through his influence that the fine pile of buildings, including the west front and Parliament Square within, were built from grants generously given by the Irish House of Commons, in the latter half of the eighteenth century. The foundation of the library began in 1601, when the soldiers, to commemorate the battle of Kinsale, subscribed £700 out of arrears of pay to buy books; and in 1661 Archbishop Ussher's library was purchased for £2200 by a similar act of generosity on the part of the Cromwellian army, and presented to the college. The Library Act of 1801 has been the chief source of supply since that date. The library contains nearly 300,000 volumes and about 2000 manuscripts. Among its chief treasures are codex Z, a palimpsest of St. Matthew's Gospel, the Book of Durrow (Gospels), Book of Armagh (New Testament), Book of Dimma, Book of Mulling (Gospels), the Book of Kells (Gospels), styled "the most beautiful book in the world," the Book of Leinster, and many others.

During the nineteenth century the magnificent block overlooking the park—"the schools," or new buildings, the new square, the medical school and museum—were erected; and the college, as far as her means permitted, made every endeavour to meet modern requirements in equipping her various departments for scientific teaching and research. In 1898 she celebrated her tercentenary, when representatives of seventy-five universities and other institutions from all quarters of the world assembled to do honour to Dublin University. The Graduates' Memorial Building is a fitting tribute from her children, not only as a mark of their affection, but as a memorial of the great occasion.

In 1798 Trinity College admitted the students of denominations other than the Church of Ireland to her degrees—more than half a century before the sister universities in Great Britain removed their disabilities. Dublin University

was also the first to grant degrees to Jewish students. It established non-foundation scholarships in 1845, to meet the difficulties students of other creeds had in taking the declaration then required of scholars. In 1858 studentships (£100 annually for seven years) were instituted and made open to all denominations; and in 1878 all religious tests were abolished, except, of course, in connexion with the divinity school. In 1904 degrees and honours were thrown open to women. Dublin was the first university to confer degrees in surgery and engineering. Lectureships in modern languages were established as far back as the eighteenth century; and English literature took its place in the curriculum long before Oxford and Cambridge gave it a place in their course of studies. The classical and moral science triposes in Cambridge were subsequent to moderatorships in these subjects in Dublin; and in specializing in physical and natural science this Irish university has played a foremost part. The main difficulty with Trinity College, as, indeed, with all the older universities, in the present and increasingly in the future, is how to meet modern requirements, scientific and otherwise, in an ever-widening curriculum, from endowments which were only sufficient while the institutions were run on the old and more confined academic lines. (For the Scientific Institutions, see p. 840.)

The Royal University, in Earlsfort Terrace, occupies the site of the Dublin Exhibition of 1864, the permanent buildings being maintained, to which considerable additions have since been made. The Royal University was founded in 1880, taking the place of the old Queen's University, and established on the same lines as London University. To it the Queen's Colleges of Belfast, Cork, and Galway are attached; the Catholic University College also sends its students, and large numbers are prepared for its examinations by many provincial colleges and schools. The large hall is one of the most commodious in the city, and here degrees are conferred yearly in the presence of a crowded assembly. A lofty clock-tower stands on the north side of the entrance, and the new south wing contains laboratories and lecture rooms. (For the Scientific Institutions, see p. 845.)

University College is on the south side of St. Stephen's Green. The following account has been contributed by Dr. E. J. M'WEENEY :—"This institution and the Medical School, Cecilia Street, represent the surviving elements of the Catholic University, which was founded in 1853 and had as its first rector the Rev. Dr. J. H. (afterwards Cardinal) Newman. It is domiciled on the south side of St. Stephen's Green, in several adjoining houses, of which Nos. 85 and 86 are the finest. Their history is not without interest. The house No. 86; at once recognizable by its imposing dimensions and the crouching figure of a lion with which the portico is adorned, was built in the middle of the eighteenth century by Richard Chapell Whaley, whose family was connected by marriage with the Cromwells, and originally came to Ireland with the Lord Protector. Richard Whaley was a wealthy and influential man, and represented Wicklow in the Irish Parliament from 1747 to 1760. He first lived at No. 87. He is said to have been stung to envy by the fine mansion No. 85, built by Sir John Meade, afterwards first Lord Clanwilliam, and to have boasted 'that he would build something to make his noble neighbour's house look like a pig-stye.' He accordingly acquired the plot of ground that intervenes between the two houses, and erected on it the magnificent house No. 86, one of the finest private residences in Dublin. The walls, ceiling, staircases and mantelpieces are lavishly decorated in the best Italian manner of the eighteenth century. After Richard Whaley's death the house remained in the occupation of his widow, and afterwards of his son John, who lived there till his death in 1847. But its most famous inmate, whose wild life and reckless exploits (many of which are exaggerated or quite apocryphal) are still, more than a century after his death, traditional in Dublin, was John's elder brother Thomas, the celebrated 'Buck' or 'Jerusalem' Whaley. This last sobriquet he earned by carrying out a successful expedition to the Holy City—at that time a difficult and hazardous exploit—for a wager of a sum variously stated at £15,000 and £20,000."

The Catholic University consists of a group of Colleges—that in St. Stephen's Green being connected with Maynooth,

Carlow, Blackrock, Clonliffe, and the Cecilia Street Medical School ; but degrees are granted only in theology and philosophy, the other professional and Arts degrees being taken out in the Royal University.

Secondary Schools and Colleges.—These are numerous, and many of them occupy large private houses never intended to be used for such purposes ; none either in wealth or dignity reaches the standard of the great and old foundations in England. But the standard of education is especially high, and can well bear comparison with that attained in the secondary schools in England. This is in a large measure due to the impetus given by the Intermediate Education Board, which was established with a grant of one million sterling out of the disestablished Irish Church funds. Since then Ireland's portion of the beer duties has been added, and the Board now administers over £80,000 a year in the shape of results fees, awards, etc., based on the results of a great general examination, which is held in the month of June.

Among the chief schools is the **High School** under the Erasmus Smith Education Board. The schools under their management were founded by Erasmus Smith, an Irish landowner, for the education of Protestant children, in 1669. The High School stands in an open space near the head of Harcourt Street.

The **Incorporated Society's Schools** are widely spread. This society was also established (1783) for the education of Protestant children, and has its chief school, recently established, in Mountjoy Square.

St. Columba's College, Rathfarnham, was founded in 1843, on the lines of the English public schools. It occupies a beautiful situation on the slope of the Dublin mountains, and has a pretty chapel.

Wesley College, St. Stephen's Green, S., is a new and well-built institution, but it cannot be seen to advantage from the thoroughfare, owing to its being shut in by the houses fronting it.

St. Andrew's College, managed by a board of Presbyterian citizens, is on the north side of the same square, and of quite recent establishment.

King's Hospital, or the **Blue Coat School**, at Oxmantown, on the north side of the Liffey, was founded in 1670 by Charles II for the children of freemen. The present building dates from 1770, and was originally intended to be crowned by a steeple. From lack of funds this was not done, but an unfinished appearance has to some extent been removed by a cupola, erected in 1904. The boys dress in uniform, which is in no sense picturesque compared with the sixteenth-century costume of the Christ's Hospital scholars.

All the chief Roman Catholic schools have been established by the teaching orders of the regular clergy. Among them are the fine **Castleknock College**, belonging to the Vincentians, and occupying a beautiful situation beyond Phoenix Park. **Blackrock College** belongs to the order known as the Society of the Holy Ghost. It stands on a fine site on the main road from the city to Kingstown, and recent improvements have thrown the college and grounds open to public view.

Belvedere College, in Great Denmark Street, belonging to the Jesuit order, occupies one of the most interesting of the old Dublin houses. The Marist Fathers have an establishment, the **Catholic University School**, in Lower Leeson Street. The well-known teaching order of the Christian Brothers has numerous schools in Dublin. **North Richmond Street Schools** are very extensive, and here about 2000 boys are educated. There is also a large school at **Marino**, Clontarf.

Alexandra College for the higher education of women faces the Royal University, and was established in 1866 by the late Archbishop Trench and Mrs. Jellicoe, its first lady principal, to whose memory the hall of the college has been erected. This college preceded Girton by three and Newnham by five years. From the first, a strong connexion has been maintained with Trinity College, Dublin; and the students of Alexandra entered for examinations specially intended for them. From 1880 the college took every advantage that the Royal University offered to women. Its students have also largely availed themselves of the recent privileges which Trinity College has

afforded by opening its doors to women, the great majority of girl-students belonging to Alexandra College. A system of training for secondary schools has recently been established ; and in general culture the Hermione art lectures and the Margaret Stokes archaeological lectures are worthy of special mention. **Alexandra School** is an attractive-looking block adjoining the college, built from designs by Mr. Kaye-Parry (1890). The school is a sister institution for younger girls, and was established in 1878.

The leading orders of Nuns conduct institutions for the education of Roman Catholic girl-students. The chief residential college is the **Loreto Abbey**, Rathfarnham, and the principal day-schools are the **Loreto College**, St. Stephen's Green, and the **Dominican College**, Eccles Street.

The **Primary School** system in Ireland is under the control of the National Education Board, established in 1881. There is no school-rate in Ireland ; and the whole cost is defrayed from direct Treasury grants. Voluntary parochial aid is given in many schools to augment the teachers' salaries, which are at a much lower scale than in England. All schools are under the control of managers, the majority of whom are clergy of the various denominations ; and they are responsible for the maintenance and heating of the schools. A recent report by specially appointed inspectors showed that the general condition of the schools was unsatisfactory ; and an annual grant of £40,000 was given in 1907 for a period of five years for the improvement of existing and the establishment of new schools. Down to 1884 the Central Training College in Marlborough Street, Dublin, undenominational, and under the direct control of the Commissioners, was the only one for teachers. The offices of the Board occupy Tyrone House, the old town residence of the Beresford family ; the College and Model Schools are adjoining. In 1884 St. Patrick's College, Drumcondra, under the control of the Vincentian order, was established by the National Board for Roman Catholic male students ; the Training College for girls is now at Blackrock. These are both in new buildings. In 1884 the Church of Ireland Training College was also

established by the National Board. It occupies the site and some of the old buildings of the Kildare Place Society's schools, founded in 1811, which passed to the Church Education Society in 1889. It has thus preserved its continuity and site as a training college; and in this latter respect is the oldest of its kind in the United Kingdom. It has been largely rebuilt and extended since 1884; and its new front is a very effective addition to the architecture of Kildare Street.

SCIENTIFIC INSTITUTIONS.

TRINITY COLLEGE.

By HENRY H. DIXON, D.S.C., F.R.S.

With the exception of the Observatory at Dunsink and the Botanic Gardens at Ball's Bridge, the scientific institutions of Trinity College are all grouped within its own precincts, and are for the most part located within the College Park.

The Museum Building—containing the Schools of Civil Engineering and Geology—forms the south side of the “New Square.” It was erected in 1857, “and is perhaps the most successful piece of modern architecture in the British Isles.” The stone-carving, both for diversity of design and delicacy of execution, is admirable. It is the work of the brothers Shea, of Cork, who were subsequently employed in decorating the Oxford Museum. The School of Civil Engineering was founded in 1842, Dublin being the first University to confer degrees in Engineering. The Drawing Room and Museum of Engineering Models are on the right at the top of a very fine staircase, while on the left is the Museum of Geology. The lower floor is occupied by the Geological laboratories and class-rooms—formerly devoted to the School of Experimental Physics—and by lecture theatres for Geology and Engineering. On the stairs is a clock electrically controlled by the mean-time clock of the Observatory at Dunsink. The Geological Museum, in addition to typical collections of minerals, rocks, and fossils, arranged for students' use, contains

many valuable and rare specimens, among which may be mentioned fine examples of *Cervus giganteus*, fossil reptiles, and the famous Dundrum meteorite. The Engineering Museum contains a variety of engineering models, e.g., a series representing the progress of invention in the steam-engine, a large collection of timber bridges, a model of the Boyne Viaduct, &c.

Leaving the Museum Building, and passing from the New Square, we see at the east end of the Park the large group of granite buildings in which the greater part of the science schools are housed. The southernmost of this group is the School of Pathology, built in 1897. It contains large and small class-rooms, lecture theatre, and research laboratories, and also gives accommodation to a department of X-ray photography.

The central block of this group of buildings, which Trinity College largely owes to the energy of the late Rev. Samuel Haughton, contains (i) the School of Chemical Science, with large laboratories and theatre for the instruction of students in pure and applied chemistry, research laboratories, and a museum; (ii) a Pathological and Surgical Museum; (iii) a Department of Materia Medica and Therapeutics, including a laboratory and a museum; (iv) the School of Anatomy. The last-mentioned comprises a large general dissecting-room, a museum, a lecture-theatre, an embryological laboratory, and a women's dissecting-room. In the Anatomical Department are displayed sections of the frozen body, and dissections and models illustrating embryonic development.

The north end of the group is occupied by (i) the Zoological Museum and Laboratories, (ii) the Museum of Anthropology, (iii) the Department of the Institutes of Medicine, which includes a large laboratory for practical physiology and histology, and a lecture theatre, and laboratories for research in physiology. The Zoological Museum contains a large series of typical specimens.

Among the rarities of the Zoological Museum may be mentioned a fine example of the Great Auk, which was taken in Waterford Harbour in 1831—the last recorded living specimen of this bird. In the gallery a set of museum microscopes are set up to exhibit specimens to students.

In the Museum of Anthropology, which is in connexion with the School of Anatomy, may be seen a representative collection of the skulls of different races. The death-mask

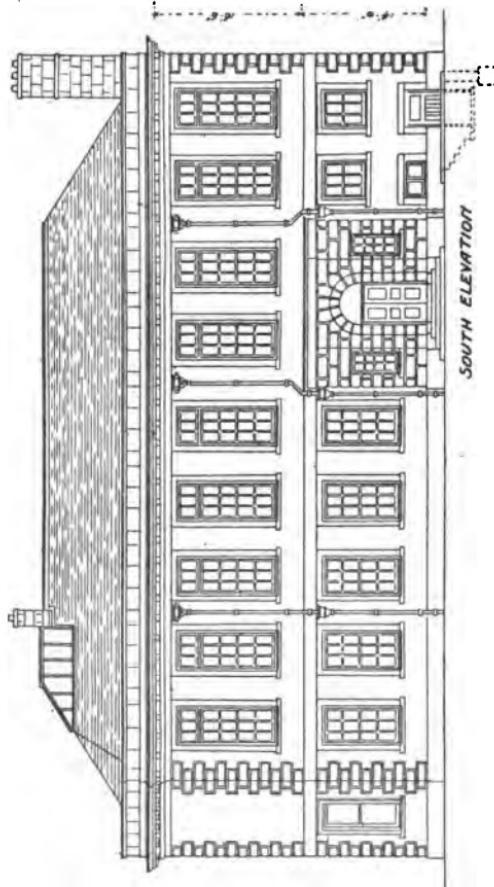


FIG. 52.—School of Botany, Trinity College.
(From *British Medical Journal*, 1907.)

of Dean Swift and the skeleton of the remarkable Irish giant Cornelius Magrath are preserved here.

Standing out from these buildings into the Park are the Schools of Experimental Physics and of Botany, the

gift of Viscount Iveagh to the University. The former was completed in 1906 and the latter in 1907. The former is a three-storied building, and gives accommodation to a

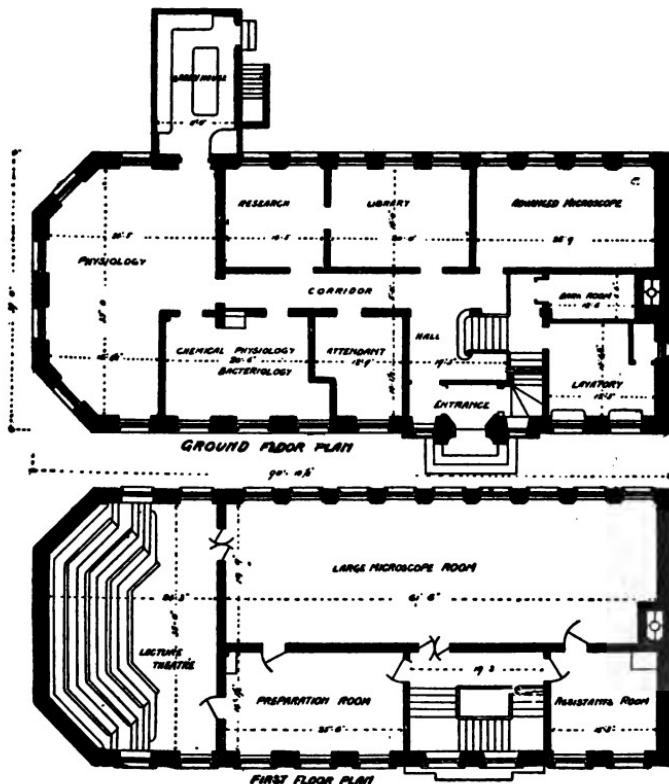


FIG. 53.—School of Botany, Trinity College.
(From *British Medical Journal*, 1907.)

fine lecture-theatre, large and small class-rooms, and laboratories suited for research in the various branches of Physics. In connexion with the School of Physics is a

Meteorological Observatory in the Fellows' Garden. The School of Botany lies to the north of the School of Physics ; it, too, contains a fine theatre, large and small class-rooms, laboratories equipped for research and instruction in Botany, a greenhouse for experimental work, and a library. In connexion with the Botanical Department of the College, though not housed in the School of Botany, is a valuable Herbarium. It, together with a library of botanical literature, presented by Dr. E. P. Wright, is accommodated in No. 5 Trinity College. Among its possessions may be noted a British collection, rich in species and varieties, including collections made by Mackay, Greville, Balfour, Henslow, A. G. More, Harvey, and others ; and a collection of algae, including many type-specimens of Harvey, Agardh, Mueller, &c. The School of Botany is also fortunate in possessing a Botanic Garden of about 6 acres, situated at Ball's Bridge, and founded in 1806. The inner garden contains a collection of the principal natural orders of hardy plants for teaching-purposes ; while in a series of seven glass-houses are grown tender and tropical exotics ; there are also several ponds for the cultivation of water and marsh plants, and suitable conditions are provided for the cultivation of trees, herbaceous, alpine, and bulbous plants.

Close to the School of Botany, on the north side of the Rugby football ground, are the Laboratories of Electrical and Mechanical Engineering—erected in 1908. In the Laboratory of Mechanical Engineering are the apparatus and machinery necessary for the instruction of students in this branch of engineering, e.g., a fine testing-machine, experimental steam-engine, and various gas and oil engines. There is also attached to it a laboratory for cement-testing. In the Laboratory of Electrical Engineering is the apparatus necessary for the instruction of students in the theory and practice of electrical engineering, together with some early forms of the dynamo, now of historic interest.

Dunsink Observatory, the residence of the Astronomer Royal for Ireland, is five miles north-west of the centre of Dublin, on an eminence commanding a superb view. The

principal instruments here are a meridian circle by Pistor and Martins, a chronograph by Grubb, a 12-inch refractor by Cauchoix, presented by Sir James South; and a 15-inch reflector, the gift of the late Isaac Roberts, F.R.S.

THE ROYAL UNIVERSITY OF IRELAND.**BY W. E. ADENEY, D.Sc., M.R.I.A.**

The Royal University Buildings are situated in Earlsfort Terrace. They include general offices, examination halls, and large, well-equipped laboratories. These last have been specially designed, and are maintained for carrying out practical examinations in the faculties of Arts, Medicine, and Engineering. The number of candidates presenting themselves for the University Examinations has been steadily increasing during the past few years, as shown by the following returns :—

Year.	No. of Candidates.
1882	1898
1902	2894
1903	3019
1904	3267
1905	3474
1906	3733
1907	4115

Fellows of the University and Examiners are appointed by the Senate to carry out these examinations; the former are also required to teach in certain specified colleges in Dublin, Belfast, Cork, Galway, and Londonderry.

Although the laboratories have been solely designed for examination work, the Senate have allowed them to be used, when possible, for research; and important investigations have been carried out in them during recent years, including the well-known work by the late Professor T. Preston, D.Sc., F.R.S., on the Zeeman effect.

UNIVERSITY COLLEGE.

By J. A. MC'CLELLAND, D.Sc., F.R.U.I.

Most of the students of University College are reading for the examinations of the Royal University, to which it is in a sense affiliated; for, while the Royal University is essentially an Examining Board, and admits to its examinations without demanding attendances at any college, it at the same time appoints University Fellows, who are required to deliver lectures at University College, the Catholic University School of Medicine, one of the Queen's Colleges, or Magee College, Londonderry. The laboratories and lecture-halls of the College are taxed to their fullest capacity in providing for the absolute necessities of students preparing for the University Examinations; and recently temporary buildings have been erected to accommodate rapidly increasing numbers. The want of funds, however—for beyond the University Fellowships attached to the College it has no public endowments—renders it impossible suitably to provide for post-graduate and general research work, although, indeed, in these domains the College is not without considerable activity.

THE CATHOLIC UNIVERSITY SCHOOL OF MEDICINE.

By E. J. McWEENEY, M.A., M.D.

This unattractive building, in the midst of no less unattractive surroundings, is the home of the medical faculty of the Catholic University—the only component of that institution which has enjoyed a career of uninterrupted success since it was founded in 1855. It is a building facing the northern end of Crow Street—a narrow thoroughfare running from Dame Street towards the river. How a school of medicine came to be named after St. Cecilia has often been the subject of discussion. The name owes its origin to a music-hall which formerly existed on the same site, having been opened in 1781 by a Mr. Johnson. It is described as a building with large gates facing the

lower end of Crow Street. Subscription balls were held here in the year 1758 ; whilst, by a curious forewarning of the ultimate fate of the premises a century later, we learn that "in the following year (1754) there was exhibited by Mr. Rackstrow the series of anatomical waxworks now preserved in Trinity College, in the production of which forty years had been spent by Denoue, Professor of Anatomy to the Academy of Sciences at Paris."¹ In 1758 this music-hall was replaced by "The New Theatre in Crow Street," which was capable of seating over two thousand persons, and maintained its position as the leading play-house in Dublin for more than half a century. Its glories waned about 1820, when the Theatre Royal was built in Hawkins Street. In 1836 portion of the site was acquired by the Apothecaries' Hall of Ireland for their medical school, which was taken over in 1855 by the Catholic University. In 1892 its internal arrangements were remodelled and greatly improved by the late Dr. Ambrose Birmingham, Professor of Anatomy. The building is, however, quite inadequate to the number of the students, in regard to which it is only surpassed by three medical schools in the United Kingdom—those of Edinburgh, Glasgow, and Cambridge.

THE ROYAL COLLEGE OF PHYSICIANS OF IRELAND.

BY SIR JOHN W. MOORE, M.A., M.D., D.S.C., D.P.H., F.R.C.P.I.

In the year 1654 Dr. John Stearne, a Senior Fellow of Trinity College, Dublin, and a physician in extensive practice in this city, founded a body called "The President and Fraternity of Physicians" at Trinity Hall, behind the south side of Dame Street. This hall was given by the Provost and Senior Fellows of Trinity College to Dr. Stearne "for the sole and proper use of physicians"; and they appointed him President of Trinity Hall.

In 1667 King Charles II granted the first charter of incorporation to "The President and Fellows of the College

¹ Gilbert's History of Dublin, ed. 1903, p. 75.

of Physicians in Dublin." This charter, while preserving the terms of contract with the Provost and Senior Fellows of Trinity College, gave the College of Physicians the general powers of the sister college in London, and specially entrusted the College with the entire control of the practice of physic in Dublin and its vicinity.

At the request of the College the Caroline charter was surrendered on December 14, 1692, and King William and Queen Mary granted a new charter, dated December 15, 1692, in which the corporation is styled "The President and Fellows of the King and Queen's College of Physicians in Ireland"—a title by which the College continued to be known until 1890. On August 5 of that year a supplemental charter, granted by Queen Victoria, ordained that "the Corporation of the King and Queen's College of Physicians in Ireland shall henceforth be called and known by the name of 'The Royal College of Physicians of Ireland.'"

The first president under the charter of William and Mary was Dr. Patrick Dun, a native of Aberdeen, afterwards Sir Patrick Dun: he was knighted by the Lords Justices of Ireland on January 29, 1696.

In 1800 Sir Patrick Dun's Hospital was founded, in conformity with the spirit of Sir Patrick Dun's will, of which the President and Fellows of the College are the trustees. The College met in the hospital until 1868, when the fine and commodious buildings in Kildare Street, now called the Royal College of Physicians, were opened. Towards the close of the year 1876 the College admitted women for the licences in medicine and midwifery, being the first licensing body in the kingdom to take this step.

On December 12, 1878, Queen Victoria granted the College a supplemental charter, of which one of the most important provisions was the institution of a grade or order of Members of the College distinct from the Fellows, and to which Licentiates of the College, or persons qualified at the time of their admission to become such licentiates, should alone be eligible.

In 1886 the College combined with the Royal College of Surgeons in Ireland to form a conjoint scheme of education

and examination, for the purpose of qualifying candidates for admission to the Medical Register.

The numerical strength of the College in 1908 is as follows :—Fellows, 67 ; Members, exclusive of 50 who were also Fellows, 205 ; Licentiates in Medicine, exclusive of 272 who were also either Fellows or Members, 2682 ; Licentiates in Midwifery alone, 281 ; total, 8285. There are besides 271 Diplomates in Public Health or State Medicine.

In the Statue Hall of the College are marble statues of Sir Henry Marsh, Dr. Robert James Graves, Sir Dominic Corrigan, and Dr. William Stokes, all of them past presidents. There are also many portraits of dignitaries of the College. The mace, of solid silver, dating from 1852, is a much-admired work of art.

THE ROYAL COLLEGE OF SURGEONS IN IRELAND.

BY SIR JOHN W. MOORE, M.A., M.D., D.S.C., D.P.H., F.R.C.P.I.

The handsome granite building on the west side of St. Stephen's Green, and at the eastern end of York Street, on its north side, is the home of the Royal College of Surgeons in Ireland.

On St. Luke's Day, October 18, 1446, King Henry VI established by Royal charter a fraternity or guild of the "Art of Barbers." This was the first incorporation of medical practitioners in the kingdom. King Henry's charter cannot be found ; but its purpose was recited in a charter granted by Queen Elizabeth in 1572, which is preserved in the Manuscript Room of the Library of Trinity College, Dublin. From the text of Elizabeth's charter it is clear that the word "barber" was the equivalent for surgeon, or "chirurgeon," in those days. It is also interesting to note that the fraternity or guild was to consist of "as well Men as Women who were willing to join as Brothers and Sisters of the Fraternity or Guild aforesaid."

The "Master, Wardens, and Fraternity of Barbers and Chirurgeons of the Guild of St. Mary Magdalene, within our city of Dublin," exercised their chartered privileges during some two centuries. By the end of that time the

surgeons in the guild had become dissatisfied with their corporate connexion with the barbers and peruke-makers. Accordingly, on March 29, 1780, a number of surgeons constituted themselves the "Dublin Society of Surgeons." This was the first step towards the foundation of the Royal College of Surgeons in Ireland, which was established by Letters Patent, dated February 11, 1784, in the twenty-fourth year of the reign of King George III, Samuel Croker-King being the first president.

The foundation-stone of the existing College buildings on St. Stephen's Green was not laid until March 17, 1806; and it was not until the year 1827 that the Doric frontage of the College assumed its present imposing appearance.

The College School of Surgery dates from 1789. In 1891 an amalgamation of medical schools was effected, and since then the Carmichael College of Medicine and the Ledwich School of Medicine have been merged in the very fully equipped and successful Schools of Surgery of the Royal College of Surgeons in Ireland. At the present day the College includes nearly 500 Fellows and nearly 8000 Licentiates, besides some 450 Licentiates in Dental Surgery.

The College Library contains about 25,000 volumes. The history of the Museum is almost coeval with that of the College. It includes departments of natural history and of pathology.

Since the passing of the Medical Act of 1886 the Royal College of Surgeons has been united under a conjoint scheme of examinations with the Royal College of Physicians, for the purpose of holding qualifying examinations in medicine, surgery, and midwifery, for admission to the Medical Register of the United Kingdom.

THE ROYAL COLLEGE OF SCIENCE FOR IRELAND.

BY GEO. H. CARPENTER, B.S.C., M.R.I.A.

This institution, situated on the east side of St. Stephen's Green, was founded in 1845 as a Government "Museum of Irish Industry," comprising exhibits in mining, metallurgy, and manufactures, including the collections of the Irish

Geological Survey, and giving instruction to the public through courses of lectures delivered by a staff of professors under the direction of Sir Robert Kane. In 1854 the scientific teaching work of the Royal Dublin Society was incorporated with that of this Museum. After several years of inquiry and discussion the Museum was reorganized in 1867 as the Royal College of Science for Ireland. During the forty years of its existence the College has been noted for the extent and thoroughness of the practical work done in its various courses, and the laboratory accommodation, having been for long too restricted for the growing activities of the place, a new building is now in course of erection in Upper Merrion Street, near the National Museum.

Until the year 1900 the College was under the control of the Science and Art Department, South Kensington. Then it was transferred to the newly-established Department of Agriculture and Technical Instruction for Ireland, under which it has developed most strongly as a college of pure and applied science, and as a centre for the training of teachers and instructors for Irish schools. There are "faculties" of Agriculture, Applied Chemistry, and Engineering, and "groups" of science teachers, specializing in Chemistry, Physics, or Natural Science. The training of itinerant agricultural instructors for the Irish counties, and of qualified science teachers for the Irish secondary schools—both in ordinary three-years courses and in special short summer courses—has been a notable feature of the College during recent years, while the former chemical, physical, engineering, and biological teaching and research have gone steadily on.

At present the Engineering Faculty is temporarily housed outside the College. In the College building on St. Stephen's Green are in the front (west) block, library, offices, class-rooms, and bacteriological laboratory; in the north block, metallurgical, chemical, and biological laboratories; in the south block, physical and geological laboratories; in the back (east) block, lecture-theatres and teaching collections. The biological, geological, and bacteriological laboratories are especially well-lit and commodious. The chemical and physical laboratories, though cramped through want of

space, contain many valuable pieces of apparatus, and have been the scene of well-known researches on spectroscopic analysis and the thermo-conductivity of metals and alloys.¹ The library contains a well-selected assortment of scientific books and some periodicals not taken elsewhere in Dublin. It is available for reference by the public.

In addition to the extensive teaching work, the College is a leading centre of scientific research, and its staff advise the Department of Agriculture on scientific questions. The Department's seed-testing station is situated here; and the economic bearing of biology and geology receives especial attention. It was appropriate, therefore, that the College should have been selected as the meeting-place of the sub-section of Agriculture during the 1908 session of the British Association.

THE ROYAL VETERINARY COLLEGE OF IRELAND.

By A. E. METTAM, B.Sc., M.R.C.V.S.

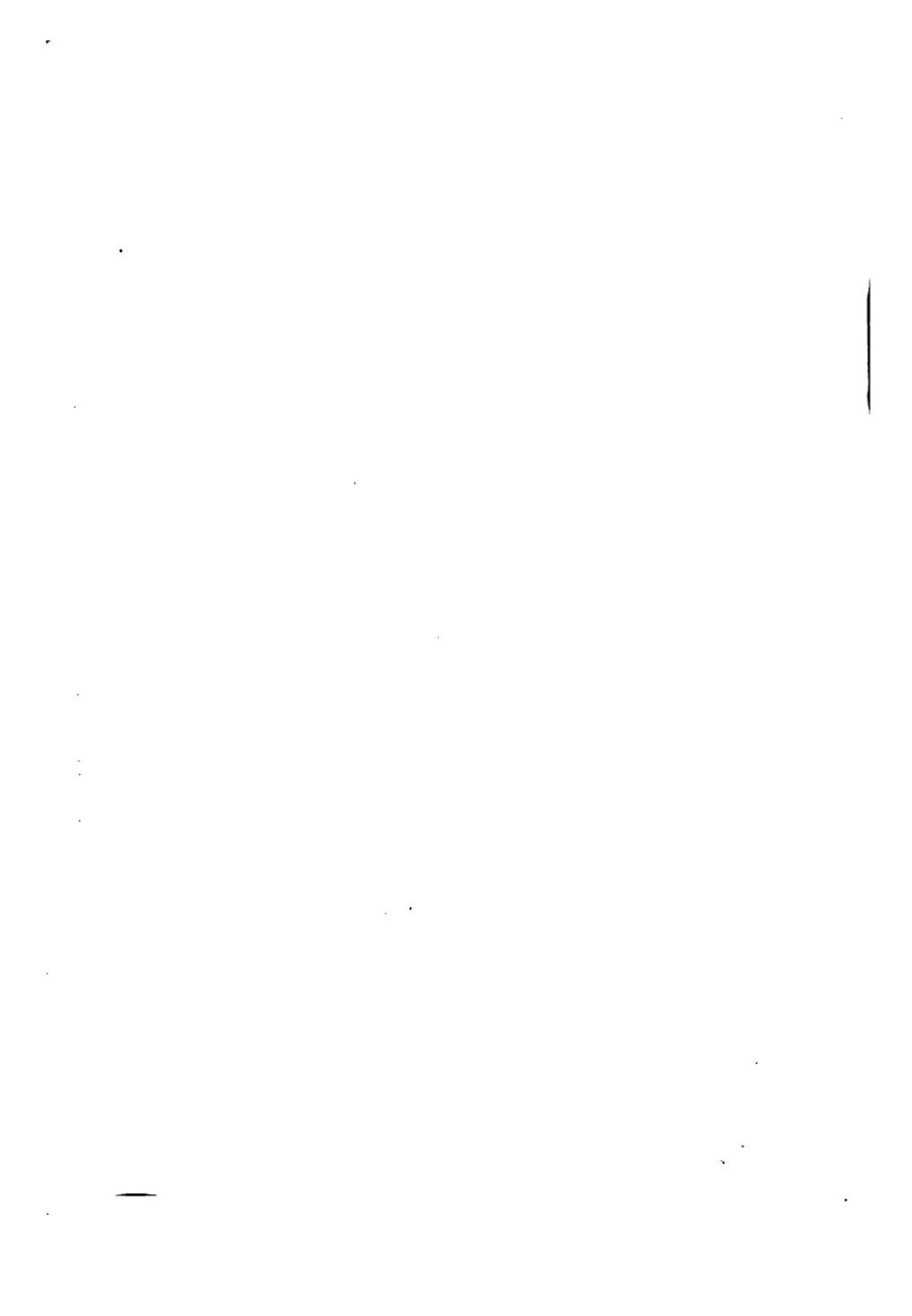
Strange as it may seem, an agricultural and pastoral country like Ireland did not until 1900 possess a Veterinary College of its own. True, in the eighteenth century the idea was mooted even before the foundation of the college in London, but nothing further was done. In the nineteenth century, at various times, the idea again cropped up, but until 1895 it did not take shape. In that year a Royal charter was granted, and the Chief Secretary of the time, Mr. John Morley, promised a grant in aid of buildings and equipment of £15,000. In 1900 the work of the college began as a teaching institution; and now it is claimed that, so far as the number of students is concerned, it is second only to the London Veterinary College. The sum above mentioned was speedily found to be wholly inadequate to build and equip an efficient and modern veterinary college; and it has been added to by the Department of Agriculture

¹ See "Ireland, Industrial and Agricultural," Dublin, 1902; and W. F. BARRETT in "The Lynx" (R. C. Se. Magazine), June, 1906.



DISSECTING-ROOM OF THE ROYAL VETERINARY COLLEGE, DUBLIN.





and Technical Instruction for Ireland, who rightly consider that modern veterinary science is indispensable to progressive agriculture and to a country where the rearing and breeding of stock demand so large a part of the national energy. The College buildings are erected upon land adjoining the Botanic Garden of Trinity College, and are entered from the Shelbourne Road at Ballsbridge. At present three blocks of buildings are complete. There are a well-equipped hospital, with stalls for horses, cattle, and dogs, a pharmacy with class-room over, an anatomical museum, a large lecture-theatre opening from a dissecting-room (Plate XXIX), so that fresh subjects can be brought in and placed on the revolving-table, an extensive biological and physiological laboratory, and a pathological laboratory with research-rooms. By the autumn of 1908 the present scheme of the College buildings will be practically complete. The staff of the College includes nine lecturers with assistants, and the governing body is a board of forty, nominated by the Crown, the Royal Dublin Society, and the Department of Agriculture and Technical Instruction for Ireland.

ALEXANDRA COLLEGE.

BY JANE STEPHENS, B.Sc.

Alexandra College was founded in 1866 for the higher education of women. A class in Botany is held weekly. The instruction is given mainly from the point of view of nature study. Special attention is also given to the study of Plant Physiology.

The study of Horticulture receives special encouragement. Practical instruction in all branches of horticulture is given to the students in the College gardens, which are to a large extent laid out with a view to afford facilities for this work. Among the special features of the gardens are a rock-garden and a wall-garden, where many rare and interesting plants are to be found. Visits are paid to the Royal Botanic Gardens and to private gardens in the neighbourhood of Dublin which present features of interest to

horticultural students. Scholarships are given yearly in connexion with both botanical and horticultural classes.

A chemical laboratory has recently been fitted up in Alexandra College. Students are prepared for examinations up to and including the examination for the B.A. degree. Facilities are also offered to students who wish to take a special course in Chemistry.

CITY OF DUBLIN MUNICIPAL TECHNICAL SCHOOLS.

BY L. E. O'CARROLL, B.A.

The Technical Schools are under the control of a Committee which is appointed by the Corporation of the city.

Dublin had the honour of being the first city in Ireland to form a Technical Instruction Committee, and to undertake practical work. As this was actually in operation two years before the passing of the Technical Instruction Act of 1889, it will be seen that Dublin compares favourably in this respect with the majority of English towns.

In 1885 there was an Artizans' Exhibition held in the city, at the close of which a provisional committee was formed to aid industrial progress by utilizing the building for technical classes. This project fell through, more suitable premises being taken in Kevin Street. A start was made on voluntary subscriptions, the collection of which commenced in 1885 ; and in the course of time help was received from the Public Libraries Committee. At the present time the chief source of income is the penny rate, which brings in about £3,500 a year ; and the Government grant which is received through the Department of Agriculture and Technical Instruction, amounting to about £9,000 a year.

In the first session at Kevin Street the students mustered a little over 200, the numbers rising to about 1,000 in ten years. As the building would not accommodate more, and students were being refused, a considerable extension was made, and the new building was opened in January, 1901. The numbers then speedily rose from

1184 in 1900-1 to 2882 in 1904-5. The chief features of the school are the Building and Engineering Classes (Mechanical and Electrical), but provision is also made for a large number of Trade Classes.

A second school was opened in Rutland Square in 1905, the chief feature of which is the Commercial Classes.

A Printing School was opened at Chatham Row in February of the present year. It contains a very modern equipment of printing apparatus and machinery, and is one of the best housed, as well as one of the best equipped, schools of typography in the United Kingdom.

THE NATIONAL MUSEUM OF SCIENCE AND ART.

BY GEO. H. CARPENTER, B.Sc., M.R.I.A.

Occupying a large area between Kildare Street and Merrion Square will be found a number of scientific and other institutions grouped around Leinster House. Northwards lie the National Library (see p. 360), the Metropolitan School of Art, and the National Gallery. To the south of Leinster House lies the Museum, the Zoological collections being housed in a building completed in 1857 on the south side of Leinster House towards Merrion Square, while the Art, Industrial, Archaeological, and Botanical collections are displayed in the new building towards Kildare Street, which was completed in 1890. The Geological, Palæontological, and Circulation collections are, pending the erection of a permanent annexe, still in temporary sheds between the two main buildings. Leinster House is occupied by the Royal Dublin Society (see p. 369), and by the administrative staff of the Museum.

The collections now brought together in these buildings have been derived from various sources. As a whole the Museum must be regarded as a continuation of the Museum founded by the Royal Dublin Society in 1782 (see p. 371), subsequently assisted and subsidized by the Government, and finally handed over to the Science and Art Department in 1877. But other institutions have contributed to the

present collections—the extinct Dublin Natural History Society, the Museum of Irish Industry (now transformed into the Royal College of Science), the Irish Geological Survey, and, above all, the Royal Irish Academy (p. 368), whose unique and valuable collection of antiquities was housed in the new Museum building in 1891. In the year 1900 the Museum was transferred from the Science and Art Department to the Irish Department of Agriculture and Technical Instruction.

Most of the contents of the new building appeal to the artist and archæologist rather than to the man of science; but there are three sections well worthy the attention of scientific students. In a long room at the west end of the ground-floor, is an excellent *Ethnographical Collection*, arranged on a plan primarily geographical. Here the habits, industries, and religions of various savage and barbarous races of men are illustrated by numerous specimens of their utensils and dress. In adjacent rooms, convenient for comparison, are exhibits illustrating the old civilizations of Egypt, Assyria, Greece, Rome, Persia, and India.

In a series of three rooms at the west end of the first floor and in the adjoining galleries will be found the famous *Collection of Irish Antiquities*, collected for the most part by the Royal Irish Academy. The first room contains relics of the Stone Age (Neolithic); noteworthy exhibits in addition to a large set of implements from various Irish counties, being portions of the old sand-covered surfaces of the Ulster raised beaches, with chipped flints, split bones, and other indications of the presence of early man. In the second room is arranged the fine series of weapons, gold ornaments, and other objects of the Bronze Age. Specially interesting to the scientific antiquarian will be the prehistoric interment of cremated human remains, conveyed bodily from Tallaght, County Dublin, to an exhibition case in this hall. The third room is devoted to the unique and splendid set of Christian Antiquities. Scandinavian and Swiss objects, for comparison with the Irish Antiquities, are shown in the neighbouring gallery.

The *Botanical Collection* is contained in a set of rooms on the top floor of the new building. The staircase leads to a well-lit gallery, around which is arranged an index-collection of the Vegetable Kingdom. From this gallery open rooms where an economic collection (the various products grouped under the natural orders) and a set of fossil plants are exhibited. As might be expected, potatoes, peat, and the osier industry receive special attention in the economic series. There is also a herbarium with extensive collections of Irish and British plants.

On his way from the new building to the old ("natural history") building, the visitor passes through some temporary structures, where the *Industrial* and *Circulation Collections* are shown. The former is small, comprising only a few looms and models of factory-plant. The Circulation Collection consists of numerous small cases adapted for loan to local museums, agricultural shows, or country schools. Economic biology in its various branches and elementary engineering are among the scientific subjects illustrated.

In this group of temporary buildings are also housed the general *Geological and Palaeontological Collections*. The relief map of Ireland, scale 1 mile to 1 inch, geologically coloured, is a conspicuous feature here; its effect is rather spoiled by the excessive exaggeration of the vertical scale (11 inches to 1 mile). Around the map are arranged the general collections of minerals and rocks. The fossils comprise a fairly extensive general collection, arranged zoologically, and a set of Irish fossil Mammalia. The general collection is noteworthy for the fine set of Liassic Ichthyosaurs and Plesiosaurs, and for the Carboniferous Cephalopoda. The extinct Irish Mammalia are among the most interesting features of the museum, including a very large series of the Giant Deer (so-called Irish Elk), of which three complete skeletons are mounted, Irish cattle, and the mammalian remains found during recent years in caves in the south and west of Ireland. Among these latter, the Arctic Fox, Brown Bear, African Wild Cat, Norwegian and Arctic Lemmings are remarkable.

A narrow, but well-lighted, curved corridor, connecting

Leinster House with the main natural history building, contains the *Geological Survey Collections*. Here will be found Irish rock-specimens, arranged under the four provinces and according to their mode of origin, and an extensive stratigraphical series of Irish fossils. This collection has been lately re-arranged; it is well illustrated with diagrams and maps; and it will prove an excellent guide to the geology of the country.

There remains the large natural history building on the south side of Leinster Lawn, in which are housed the



FIG. 52.—National Museum : Irish Zoological Collection.

Zoological Collections. At the east end of the ground-floor close to the Merrion Square entrance, will be found a small case, arranged to illustrate the Factors of Animal Evolution, and a series of cases showing the elementary facts of Geographical Distribution, faunistic groups being arranged according to the well-known regions of Sclater and Wallace. The attention of visitors is especially called to a small case at the north-western corner of this section, in which are illustrated some features in the fauna of the British Islands, notably the presence of rare southwestern and northern forms of life in Ireland. The rest

of the ground-floor of the building is devoted to as full an exposition of the Irish Fauna as possible. In addition to the exhibition of every recorded species of which specimens can be obtained, life-histories are in many cases illustrated, notably among the Lepidoptera and the Birds. The series of mounted groups of birds, with nests and young or eggs, is worthy of careful study. In the lobby adjoining, a further series of eggs of Irish birds will be found, and a large case illustrating the nesting-habits of the herring gull. Of particular interest also are specimens of deep-



FIG. 53.—National Museum : General Zoological Collection.

sea fishes, recently obtained from the Atlantic depths off the west coast of Ireland. The upper floor of the building with its galleries contains the general Zoological Collection. The invertebrates are arranged around the top-gallery, the lower vertebrates, fishes, amphibians, reptiles, and birds around the lower gallery, and the mammals on the floor. The collection is representative, and special pains have been taken to choose good and well-mounted specimens for exhibition. The specimens of invertebrates are supplemented by numerous explanatory drawings, glass models,

and life-history groups. Representative fossils are inserted in their systematic positions. Noteworthy exhibits among the mammals are a marsupial mole (*Notoryctes*), a Liberian hippopotamus (*Choeropsis*), an okapi, a family of Alaskan fur-seals, and specimens of Weddell's and other Antarctic seals. The collection of mounted skins and skeletons of the Primates is fairly complete, and a set of casts of human skulls and faces is instructive for comparative purposes.

Adjoining the exhibition building are the offices and workrooms, where extensive study-collections are stored. The series of British and Irish insects and molluscs are well worth the attention of special students of these groups.

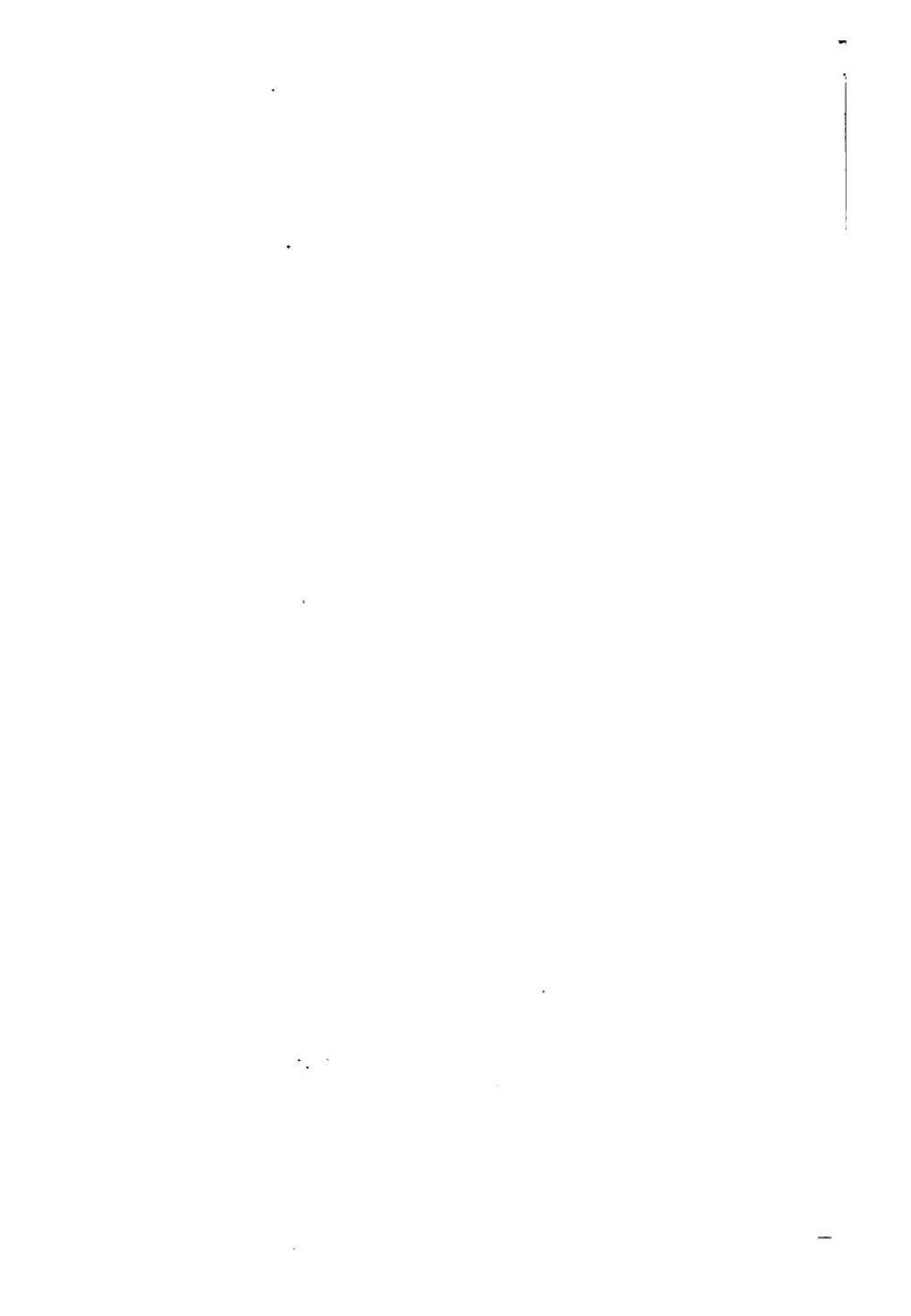
THE NATIONAL LIBRARY OF IRELAND.

By T. W. LYSTER, M.A.

The Royal Dublin Society's Library was taken over completely by the State in 1877, and renamed "National Library of Ireland." The Library had been explicitly public since 1886, when a Parliamentary Commission on the Society had recommended the title National Library of Ireland. Practically, there is evidence to show that the Library had been public on the same terms long before 1886.

From 1877 to 1900 the Library was under the Department of Science and Art. In 1900, with the Museum, it passed to the care of the Irish Department of Agriculture and Technical Instruction. It is under the direct government of trustees—eight elected annually by the Royal Dublin Society, four appointed by the Lord Lieutenant of Ireland. The annual grant for book-purchase is at present £1300. A librarian, three assistant librarians, two cataloguers, and twenty library attendants form the technical library staff.

In 1890 the Library moved into the new building, still unfinished. The architect, Sir Thomas Deane, formed his plan in consultation with the librarian, William Archer, F.R.S. The building has good points—the central reading-room, the stack system of book-cases in the book-store, the





IN THE ORCHID HOUSE, ROYAL BOTANIC GARDENS, GLASNEVIN.

hydraulic lift from basement to attic. The reading-room contains some thousands of volumes for public reference without intervention.

The book-classification is the "decimal" system invented by Melvil Dewey. Under this system each new book joins others on the same subject already on the shelves, and this to the finest subdivision. The system was introduced in Ireland by William Archer, F.R.S., librarian from 1877 to 1895.

Except on Sundays and about three weeks annually, the Library is open to the public from 10 a.m. to 10 p.m. Readers' attendances in 1849 were estimated at over 8000 a year. By 1878 they numbered 27,452; in 1904-5, 198,274; in 1907-8, 190,657. The number of printed volumes may be estimated at 180,000. This is much the largest public library in Ireland. The collection of printed books is exceeded only by that of Trinity College, where there are probably twice as many. There are extremely fine collections of bound newspapers and of maps, especially Irish. The Library is rich in books on Irish topography, history, and biography. The sections Botany, Agriculture, Zoology, the Fine Arts, and Archaeology have long been good; and since 1877 efforts have been made to reinforce Literature, History, Theology, Philosophy, and Political Economy. The manuscripts are few, and comparatively unimportant.

THE ROYAL BOTANIC GARDENS.

By F. W. MOORE, M.R.I.A.

The Royal Botanic Gardens, Glasnevin, were founded by the Royal Dublin Society in 1794. In 1790 a resolution was passed at a meeting of the Royal Dublin Society that a botanical garden should be founded, the chief object of which was "to increase and foster a taste for practical and scientific botany." The Irish Parliament of that day adopted the scheme and made various grants; so that in 1794 there was sufficient money to purchase the site on which the garden now stands, and to start laying out the ground.

The management was entrusted to a Committee of Botany, selected from members of the Royal Dublin Society, an annual vote for maintenance being made by the Government. The Garden remained under the charge of the Royal Dublin Society until 1877, when it was transferred to the Science and Art Department. In 1901 it was transferred to the Department of Agriculture and Technical Instruction for Ireland—a purely Irish department—and under the care of this body it now is.

The objects for which the Gardens were founded have been steadily adhered to; and they hold a high position as an institution where practical gardening and scientific botany can be studied.

For teaching purposes and for private study a large portion of the Gardens is devoted to an arrangement of plants grouped in their orders, each order, or family, having a bed to itself. As this arrangement was made on the Candollean system, now to some extent superseded, each label giving the name of the order has also on it the number which that order bears in Bentham and Hooker's "Genera Plantarum," so that reference can easily be had to it. The collections of hardy plants in these beds are complete and representative. Teachers have free access to these collections during the hours the Gardens are open to the public, and they bring their students for demonstrations.

The Arboretum is also extensive, and there is in it one of the best public collections of trees and shrubs. There are also an excellent collection of alpines, and an aquatic garden and bog-garden.

In the conservatories there are rich and comprehensive collections of tender plants, ferns, succulent plants, hard-wooded plants, palms, cycads, and orchids. The collections of palms, cycads, and orchids (Plate XXX) are specially worthy of attention, as, outside Kew, they are the most complete collections in any public garden. No attempt at regular, systematic, or geographical arrangement is made indoors. Where possible the various groups are kept together; otherwise they are arranged according to their cultural requirements.

Large quantities of specimens for teaching purposes are

cut, and distributed to the various prominent teaching bodies, this being one of the most important of the scientific functions of the Gardens.

As regards practical horticulture, a number of young men are taken as improvers. They come for a fixed period of two years, and, besides practical work in the Gardens, they get courses of lectures on horticulture and botany.

A portion of the Gardens is made up of a series of plots, in which the principal agricultural plants, economic plants, and vegetables are cultivated; so that those interested in horticulture and agriculture can note the various plants grown, and the methods of cultivating them.

The Gardens are open in summer from 10 a.m. to 7 p.m. The conservatories are open from 10 a.m. to 5.30 p.m.

THE ALBERT AGRICULTURAL COLLEGE.

By GEORGE STEPHENSON.

The Albert Agricultural College, situated at Glasnevin, about a mile beyond the Botanic Gardens, is equipped for giving theoretical and practical instruction in agriculture and horticulture. Founded originally in the middle of the last century by the Commissioners of National Education "to qualify elementary schoolmasters to instruct their pupils in the theory of agricultural science," the Albert Institution became the chief centre in Ireland for the training of farmers and land stewards. In the year 1900 it passed under the control of the newly-formed Department of Agriculture and Technical Instruction for Ireland, by whom considerable extensions and improvements have been made in the College and farm buildings and equipment. It occupies in the Department's scheme of education a position intermediate between that of the provincial agricultural stations (Ballyhaise, Clonakilty, Athenry) and that of the agricultural faculty of the Royal College of Science, Dublin. There are now several good class-rooms and an extensive laboratory for the study of agricultural chemistry, while biology is taught in a temporary laboratory.

At present there are in residence about sixty agricul-

tural students undergoing a one-year's course of instruction in class-room, laboratory, farm, and workshop. Ten non-resident students are also being trained in the College and gardens for the work of county itinerant instructors in horticulture.

The College farm serves as a distributing centre for pure-bred stock, and also as an experimental station for the testing of new varieties of seed.

THE AVONDALE FORESTRY STATION.

By E. A. MONTMORENCY MORRIS, M.A., M.R.I.A.

The Avondale estate, at one time the property of Charles Stewart Parnell, was acquired by the Department of Agriculture in 1904, on the advice of the eminent Indian Forestry expert, Dr. J. H. Nisbet, for the purposes of a forestry station. The greater part of the estate lies on the west bank of the river Avonmore, and runs from about one mile south of Rathdrum towards Ovoca, the total length of the estate being about two miles. The surrounding district is well wooded, and is almost unequalled for the purposes of a forestry school.

The total area of the Avondale property is about 550 acres. Until 1905 this was divided into woods and pasture. Of the pasture land a considerable part was heavily wooded. The woodland portion was chiefly confined to the banks of the river, and was covered with hazel scrub, or coppice, with a few ash, oak, and other trees. The soil of the estate consists of a thin gravelly loam, resting on metamorphosed slate or schist, which crops out on the surface in many places. A few acres of alluvial sand and gravel occur, but otherwise the soil varies little in character throughout. The ground is naturally well drained, and is suitable for the growth of all kinds of trees, but more especially conifers.

The elevation varies from about 250 feet along the river bed to about 400 feet on the highest ground. Along the eastern boundary the surface slopes away rapidly from the high ground to the river below (Plate XXXI). The local



At THE FORESTRY STATION OF THE DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION,
AYONDALE, Co. WICKLOW.





climate is comparatively damp and mild, with a heavy rainfall throughout the winter. Two or three miles to the west the Wicklow mountains provide a certain amount of shelter, and the ground is nowhere greatly exposed to west or south-west winds.

The laying-out of the estate as a forestry station was begun in the winter of 1904-5 by the removal of old fences and hedges, the clearing of part of the old woodland, and the re-planting or planting of a few acres of land. This work was preliminary to the planting of the forest plots, pinetum and arboretum, which are now the chief features of the station, the object in view being that of combining the planting of these with the forestry school for working foresters and woodmen.

The forest plots are intended to demonstrate the growth and development into timber of all the more important species of trees under sylvicultural, as distinct from arboricultural, conditions. The arboretum occupies the ground round the mansion house, which is heavily stocked with old park timber. This timber consists mainly of beech from 100 to 200 years of age, together with oak, Spanish chestnut, larch, and elm. The young trees will consequently grow up around, and eventually take the place of, the old timber as this is removed, or succumbs to wind or decay. The pinetum occupies the slope immediately below and to the south of the house. This slope was previously almost bare of timber trees; and as the young trees develop, they will form a prominent feature of the station.

The principle upon which the arboretum and pinetum have been laid out is that of demonstrating the growth, botanical character, and ornamental value of all the hardy trees capable of thriving in Ireland. These two adjuncts to the forest plots have both a botanical and arboricultural value; and thus, while affording material for the instruction of the forestry students, they will also illustrate the comparative value of the various species as ornamental features of the landscape, the garden, or the vicinity of a dwelling-house.

In the arrangement of the trees attention has been paid

to landscape effect, and clumps, groups, and single trees have been distributed in as natural and harmonious a way as possible. The arboretum contains about 150 species belonging to about 40 genera, and the pinetum about 101 species belonging to about 20 genera.

The forestry school at Avondale was opened in the autumn of 1904, with the object of training young men as working foresters and woodmen for employment in Ireland; and so far the laying out of the station has been closely associated with the working of the school. The main idea in view in connexion with the school has been the training of men in such practical forestry as is carried out in well-managed woods in these countries.

According to an article published in the *Journal of the Department of Agriculture and Technical Instruction*, the function of the Avondale Forestry School is neither that of training men in the theory of forestry alone, nor of manufacturing rule-of-thumb labourers, but in so combining theory with practice that the men trained there can adapt themselves to the varied conditions under which in all probability they will have to work in the future. To attain this end, applicants for training are received as apprentices, and practical work has been made the basis of the instruction. Science and theory are included in so far as they are necessary to supplement practical work, and to invest it with sufficient intelligent interest to destroy its monotony, and prevent mere rule-of-thumb practice. Before being admitted to the school a man must show that he has not only done manual work in the past, but is willing to continue to do such work; and every precaution has been taken against the possibility of training men for positions they may never have the opportunity of filling.

THE GEOLOGICAL SURVEY OF IRELAND.

By GRENVILLE A. J. COLE, M.R.I.A., F.G.S.

The Geological Survey of Ireland has its office at 14 Hume Street, while its collections are exhibited in a special gallery of the Museum of Science and Art. It may be regarded as a direct successor of the geological branch

of the Ordnance Survey of Ireland, instituted under Colonel Colby and Lieutenant Larcom in 1838. Captain Portlock, who was placed in charge of the geological inquiries, and who instituted a laboratory for the examination of soils, records that in 1840, "at a period when every section of the department was moving forward with a prospect of success, . . . the office, museum, and laboratory at Belfast were . . . broken up, and everything connected with the department removed to Dublin" (*Report on County of Londonderry, &c.*, p. 6). Official geological work was, however, continued by Sir R. J. Griffith, under the Valuation Office; and an admirable geological map of Ireland was published on the scale of four inches to one mile.

In 1844, Sir H. T. De la Beche, as Director-General of the Geological Survey of the United Kingdom, formed an Irish geological staff, including T. Oldham and G. Du Noyer, who had worked with Portlock. The former of these became Local Director for Ireland in 1846, and, on his accepting an appointment in India, was succeeded by J. Beete Jukes. The great development of our knowledge of the details of the geological structure of the southern half of Ireland coincides with the nineteen years during which Jukes controlled the issue of the maps and memoirs of the Survey. It was left to Professor Hull, in 1869, to carry on the work in the intricate districts of the north-west and north; and by 1890 a geological map, on the scale of one inch to one mile, and an explanatory memoir, had been produced for every area of the country. The local directorship was then abolished, and the staff was considerably reduced. Some of the publications naturally now required revision; and an important step forward was taken in 1901, when Mr. G. W. Lamplugh, as District Geologist, organized a series of maps round the great cities, showing the superficial deposits for the first time in detail.

In April, 1905, the Survey was transferred from the Board of Education in London to the Department of Agriculture and Technical Instruction for Ireland, and the Professor of Geology in the Royal College of Science

was appointed Director, with the help of a Senior Geologist to conduct the operations in the field. The examination of soils had been already revived, in connexion with the memoirs on the districts round the great cities; and a special assistant has now been appointed to facilitate this work. This staff in 1907-8 was mainly occupied with a re-survey of the beds of iron-ore, bauxite, and other materials occurring between the basaltic lava-flows in north-east Ireland, especially with a view to determining their extent and mode of origin; and a soil-survey was made of the agricultural station at Ballyhaise.

THE ROYAL IRISH ACADEMY.

BY R. MACALISTER, LL.D.

In the year 1688 a Society was formed in Dublin similar to the Royal Society, which a few years previously had been established in London, Sir William Petty becoming President, and William Molyneux, Secretary; but, owing to the disturbed state of the kingdom, its meetings were suspended in 1688. Early in the following century efforts were made to resume its functions; and at length, in 1782, the Society from which the Academy directly arose was established. Its members, most of whom belonged to the University, met at weekly meetings, and read papers in turn; and, in 1785, a Royal Letter under the Privy Seal was issued incorporating the Academy. The charter was enrolled in January, 1786. The sphere of the Academy's work was not confined to science in the more restricted sense of that word, but also included polite learning and scientific archaeology. In the Transactions and Proceedings of the Academy appeared the principal works of Brinkley in Astronomy; Kirwan in Chemical Physics; Hamilton on the Calculus of Quaternions and Theories of Rays; Lloyd on Conical Refraction, on the Meteorology of Ireland, and on Magnetism; MacCullagh in Pure Geometry; Hincks in Egyptology and Assyriology. Many important investigations in physical science and natural history have been from time to time carried out on the initiative of the Academy. A series of

observations on the tides along the coast of Ireland was made by Dr. Haughton in 1866; and in 1887, a magnetic observatory was established at Valentia, at which regular observations have been made for many years. The expenses of the second expedition to Rockall were partly defrayed by the Academy, and a report upon the expedition has been published in the Transactions. The Academy established in 1898 a Committee which has since that time been engaged in a systematic investigation of the fauna and flora of Ireland; and during the last six years this Committee has extended its operations so as to include an examination of some of the caves of Ireland. The Academy has also for some years carried on an Anthropological and Ethnographic Survey of Ireland; many illustrated reports on this subject have appeared in the Proceedings, and a set of standard instruments for measurements has been placed in the Anthropometrical Laboratory of Trinity College. The Academy's special investigations have not, however, been confined to Ireland. It has assisted in the ethnographic exploration of Torres Straits; in a survey of the botany of Sinai and South Palestine, and of the marine botany of W. Australia; an exploration of the New Zealand glaciers; and in deep-sea dredgings in various parts of the ocean, as well as in observations at foreign stations of recent solar eclipses.

The Academy's Library includes an extensive collection of the serial publications of the most important scientific societies of the world and of the chief works bearing on the history and archæology of Ireland.

THE ROYAL DUBLIN SOCIETY.

BY RICHARD J. MOSS, F.I.C., F.C.S.

On June 25th, 1781, a meeting was held in the rooms of the Philosophical Society of Trinity College, at which it was agreed to establish a society to be called, "The Dublin Society for improving Husbandry, Manufactures, and other Useful Arts." A fortnight later it was agreed to add the words "and Sciences" after the words "Useful

"Arts" in the title. In 1749, through the influence of the Earl of Chesterfield, the Society was incorporated by Royal charter. The title "Royal" was added in 1820, when George IV became the Patron of the Society.

At the early meetings, the business consisted in the reading and discussion of papers on agriculture, manufactures, art, and science. In 1740, the Rev. Samuel Madden settled a sum of £180 per annum upon the Society, and obtained promises of annual subscriptions, amounting to a further sum of £500. In 1746 George II granted an annuity of £500 from the Privy Purse. This income gave a new direction to the work of the Society, which gradually became the medium for the administration of a system of prizes and premiums. Just before the Union, the Society's grant from the Irish Parliament was £15,500. The premium system had a marked effect in reviving many branches of industry which, in earlier years, had been effectually crushed by legislation in the interests of British manufactures and commerce. Under the Imperial Parliament the system was soon discontinued, the vote in aid was reduced, and was allocated to the maintenance of the scientific and educational institutions the Society had established.

In 1782 a plot of ground was taken at Ballybough Bridge, and laid out as "a nursery for raising several sorts of trees, plants, and roots, which do not at present grow in this kingdom, but are imported from abroad, and when raised in such nursery, may be dispersed to be propagated in the country." In 1786 a larger site was acquired at St. Martin's Lane, Marlborough Street, and in 1795 the Society secured a site at Glasnevin, and established the gardens now known as the Royal Botanic Gardens. (See p. 361.)

From an early date the Society acquired books by purchase and by presentation. The earliest catalogue, which is not dated, includes thirty-six volumes, published between the years 1618 and 1786. The Library was opened to the public in the year 1808. When it was transferred to the Crown in 1877, under the title of the National Library of Ireland, the Society retained the

scientific serials, and the publications of learned societies, and these formed the nucleus of the general library it has since accumulated.

Art received marked encouragement under Rev. Dr. Madden's prize system. In 1758 a regular school of Art was established. George Barrett, one of the founders of the Royal Academy of London, was educated in this school. James Barry's reputation was established by a work he exhibited at one of the Society's exhibitions in the year 1768. The late John Henry Foley, R.A., was perhaps the most eminent of the many sculptors trained in the Society's school. It became a Government school in 1877, under the title of the Dublin Metropolitan School of Art.

The beginning of the Museum may be traced to the year 1782, when the Lords Justices were asked to grant the use of a vault under the Parliament House for the Society's collection of "Instruments." Two years later the collection was opened to the public on two days in the week. This collection consisted chiefly of models of improved forms of agricultural implements and machinery, but natural history specimens were soon added. In 1792, the Irish Parliament, at the suggestion of Richard Kirwan, the chemist and mineralogist, voted the sum of £1200 for the purchase of the collection of Professor Leske, of Marburg. This collection contained 7331 specimens, chiefly mineralogical and geological, and is described by Kirwan as "the only one that contains specimens of almost every known species, arranged on fixed principles, and, at least for the most part, truly denominated." An apartment was specially erected for the collection, on the Society's premises in Hawkins Street (now the site of the Theatre Royal), and Mr. William Higgins, who afterwards became the Society's Professor of Chemistry, was placed in charge of it. It was at this period the Society provided the Chemical Laboratory it continues to maintain at the present time. In 1815 the museum was moved to Leinster House (see Plate XXVIII); and in 1859 the present Natural History Museum was erected on the south side of Leinster Lawn.

With the growth of the scientific institutions the Society's work became more educational. Additional professorships were created; and it was the duty of the professors to deliver systematic courses of lectures in Dublin and in the provinces. The lectures were free to the public; and the average attendance at each lecture in Dublin was from 400 to 500 persons. Distinguished scientific men were also invited to lecture. In 1810 Mr. (afterwards Sir) Humphry Davy delivered a course of lectures, for which he received a fee of 500 guineas; and in the following year he delivered another course, and received a fee of £750. In 1854 the educational staff was, at the request of the Government, transferred to the Museum of Irish Industry, of which Sir Robert Kane, who had been the Society's Professor of Natural Philosophy, was Director. This institution subsequently became the Royal College of Science for Ireland. (See p. 350.)

Early in the nineteenth century a number of inspectors were appointed to make statistical surveys of the different counties; twenty-one volumes of these surveys were published by the Society. They are now important works of reference, and interesting records of the industrial state of Ireland a century ago. Out of this work arose the Geological Survey of Ireland. It began with the survey of the County of Kilkenny, which was entrusted to Mr. (afterwards Sir) Richard Griffith, the Society's Mining Engineer. The survey subsequently extended to the rest of Ireland; and Griffith's geological map is still a standard work. A difficulty arose in this work for want of proper maps of the country. The Society commenced a trigonometrical survey; and considerable progress was made in the south of Ireland when the Government took over the work by the creation of the Ordnance Survey Department.

In 1834 the Society held the first of a series of triennial exhibitions of Industry and Art. The exhibition of 1850 was the first international exhibition held in the United Kingdom. In 1858 a still more ambitious project was carried out with the liberal aid of Mr. Dargan, who acted as sole guarantor. This exhibition was opened by Her late Majesty Queen Victoria. The Irish section of the

Jubilee Exhibition, Manchester, was organized by the Royal Dublin Society.

Meetings solely for the reading and discussion of papers on scientific subjects were not held until 1836. At the first of these meetings the Professor of Chemistry, Dr. Edmund Davy, gave an account of his discovery of the gas now known as acetylene, a discovery often erroneously attributed to Berthelot. The proceedings of those meetings were not at first printed separately. In 1855 a volume appeared, containing the papers read during the preceding seven years. This publication was succeeded by the Journal, of which seven volumes were issued up to 1877, when the present series of Scientific Transactions and Proceedings commenced. The series entitled Economic Proceedings commenced in 1900.

The promotion of husbandry was one of the primary objects of the Dublin Society, and a great deal was achieved in early years in improving methods of tillage, in reclamation and drainage, and in the introduction of new crops. Under the Imperial Parliament, State aid for agriculture soon ceased. For a few years a body, called the Farming Society, which was subsidized and largely controlled by the Dublin Society, carried on the agricultural work, but mainly in its pastoral aspects, and by means of cattle shows held in Dublin and Ballinasloe. In 1880 the Marquis of Downshire induced the Royal Dublin Society to resume its interest in agriculture. The new effort took the form of cattle shows, which were held in the grounds adjoining Leinster House. These shows had assumed considerable importance when, in 1877, the site upon which they were held was acquired by the Government. The shows were transferred to Ball's Bridge, where they have undergone a remarkable development. The Society has already expended upwards of £80,000 in enclosing and laying out about forty acres, erecting buildings which cover seven acres, and constructing a branch railway. The show of breeding cattle in the spring, and of horses in the autumn, are the largest of their kind in the United Kingdom.

THE ROYAL ZOOLOGICAL SOCIETY.

BY R. F. SCHAEFF, PH.D., M.R.I.A.

The Zoological Society of Dublin, which afterwards became the Royal Zoological Society of Ireland, was founded in 1880. At a public meeting, held in that year in Dublin, a resolution was passed "that the object of the Society shall be to form a collection of living animals on the plan of the Zoological Society of London." For the London Society had come into existence a few years before. As Dr. Whitley Stokes humorously put it, "since man is partly indebted to the beast of prey for his civilization, it was clearly our duty, in the spirit of philosophical reciprocity, to return the compliment by taking the education of the beast of prey under our care." The Duke of Northumberland, who was then Lord Lieutenant of Ireland, intimated to the new Society that he had arranged to give a portion of the Phoenix Park for the purpose of establishing a Zoological Garden. And in the same year arrived, as a gift from the London Society, two Wapiti deer, one Nylghai, two Emus, two Ostriches, and several less important animals, some of which had formed part of King William IV's menagerie in Windsor Park.

A collection of living animals, no doubt, serves to stimulate among the people a love for animals and a taste for natural history. The Dublin Gardens have also been of much value in aiding students in veterinary studies, in spreading a more general knowledge of science and art, and in providing an institution for observing the natural habits of animals. As a philanthropic institution the Zoological Gardens in Dublin occupy a prominent position, for the public are admitted at a nominal price on Sundays, and charitable institutions altogether free (Plate XXXII).

The Gardens are managed by a Council, who meet at breakfast once a week before proceeding to transact the business of the Society; and it is this friendly intercourse among the members of the council which promotes the lively interest shown by the whole community in the affairs of the Society and in the welfare of the Gardens.

PLATE XXXII.

[*To face page 374.*



IN THE ZOOLOGICAL GARDENS, PHOENIX PARK, DUBLIN.





The Society has been particularly successful in the breeding of lions, so much so that the "Irish lion" has acquired quite a fame among connoisseurs. Lions have been exported from Ireland all over Europe; even Burma can boast of the possession of a Dublin lion. The regular breeding stock was started in 1855 by the purchase of a pair of imported lions from Natal. The first litter was born in 1857. Since that time up to the present year 260 cubs have been born in the Gardens. As a large number of these have been sold to or exchanged with other zoological



FIG. 54.—Lion born in the Dublin Zoological Gardens, and kept continually in open-air den.

gardens, it is no wonder that the Irish lion is now met with in many other countries besides his native land.

On an average about twenty lions and lionesses of all ages are on view in the Dublin Zoological Gardens, and it may be safely asserted that nowhere can the characteristic features and habits of the lion be studied to greater advantage than in Dublin.

One of the most important features of the Dublin Zoological Gardens is the extent to which the open-air treatment of animals has been carried out.

Some of the lions have not only been kept in an open unheated shelter summer and winter, but have even reared their young successfully under these conditions. Since this first experiment, part of a large open-air aviary has been handed over to a colony of Rhesus monkeys from India, and these have now passed their third winter in the Gardens in this unheated cage. Their splendid condition testifies to the success of this experiment. Open-air treatment was next tried upon the smaller carnivores, such as



FIG. 55.—House for small Carnivores and other Mammals,
Dublin Zoological Gardens.

mungooses, meerkats, suricates, and others, most of which have done well in the newly erected house (fig. 55). This building is of an octagonal shape, and contains some novel devices not hitherto carried out in similar structures. The fronts of the cages have no bars or other obstruction to impair the view of the spectator. The cleaning and feeding are done entirely from a passage in the rear. The animals are

also admitted to their dens from the same passage. While perfectly sheltered from the rain, unheated air communicates freely with the cages in front ; and the building, as a whole, presents a pleasing character.

Recently another series of unheated dens has been constructed for the large carnivores, such as wolves, hyænas, and pumas, in which the cleansing and feeding of the animals is likewise done from a passage in the rear of the cages.

THE ROYAL ACADEMY OF MEDICINE IN IRELAND.

By SIR JOHN W. MOORE, M.A., M.D., D.S.C., D.P.H., F.R.C.P.I.

Towards the close of the year 1882 the existing Medical Societies in Dublin agreed to amalgamate and to constitute "The Academy of Medicine in Ireland." The combining Societies were the Medical, Surgical, Obstetrical, and Pathological ; and accordingly the Academy at first consisted of four sections—those of Medicine, Surgery, Obstetrics, and Pathology. To these were added two sub-sections, those of Anatomy and Physiology, and of Public Health and State Medicine. The first President was the late Dr. Banks, Physician to Queen Victoria, afterwards Sir John Banks, K.C.B., Physician to the King.

In 1887, in connexion with her Jubilee and in the presidency of the late Dr. Robert McDonnell, F.R.S., Queen Victoria commanded that the Academy should be called "The Royal Academy of Medicine in Ireland." In the same year the sub-sections of Anatomy and Physiology and of State Medicine were raised to the dignity of sections, each with a president instead of a chairman.

The sections of the Academy meet on Friday evenings during the months from October to May, inclusive, alternately in the halls of the Royal Colleges of Physicians and Surgeons. At the end of each session a volume of Transactions is published, under the editorship of the General Secretary. Twenty-five volumes of the Transactions have been already published. They contain all that is best in medical science, research, and literature in the Irish School of Medicine.

THE DUBLIN MICROSCOPICAL CLUB.**By F. W. MOORE, M.R.I.A.**

The Dublin Microscopical Club was founded some sixty years ago by a number of men interested in science, and desirous of furthering microscopical study. The club was originally limited to twelve members, and there was a meeting of the club at the house of each member once a year. There were also a limited number of visiting members elected.

The work of the club was not confined to any one branch of science, zoologists, botanists, and geologists being equally interested in it. One of the rules stated that all objects exhibited must be connected with original work, or discovery, by the exhibitor, which greatly helped forward the objects of the club; and much valuable work was done and published by the members.

In March, 1898, alterations in the constitution of the club were made. The number of members was increased, visiting members were abolished, and, by kind permission of the Council of the Royal Dublin Society, the monthly meetings are held at Leinster House. The club meets there on the second Wednesday of each month, from October to May, inclusive, and much useful work is still done. Many important additions to the Irish microscopic flora and fauna have been exhibited for the first time, and publicity given to them in the proceedings of the club, which are now published in "The Irish Naturalist."

THE DUBLIN NATURALISTS' FIELD CLUB.**By R. LLOYD PRAEGER, B.E., M.R.I.A.**

The club was founded early in 1886 for the practical study of zoology, botany, and geology, chiefly in the province of Leinster. Its initiation was due to Professor A. C. Haddon, F.R.S., who became the first vice-president, Prof. E. Perceval Wright, M.D., occupying the presidential chair. The club made a successful start; and, with certain

fluctuations in its prosperity, has continued to fulfil with fair success the objects for which it was established ; summer and winter excursions and winter evening meetings have been held regularly. The founding of the Irish Field Club Union in 1894 has brought it into contact with the sister clubs in Belfast, Cork, and Limerick, and joint excursions have had a useful and stimulating effect. The club was mainly instrumental in founding, in 1892, "The Irish Naturalist," in which its proceedings are regularly published. This little society serves as a useful training-ground for membership of the larger scientific societies of Dublin.

INDUSTRIES AND COMMERCE.

THE PORT OF DUBLIN.

By W. E. ADENBY, D.Sc., F.I.C.

DUBLIN is situated on the Liffey, at the head of a bay six miles long and five and a half miles wide. Large quantities of sand, brought in by the sea, have accumulated in the bay, forming extensive strands, which are laid dry at low water for a distance of about two and a half miles seaward. The position of Dublin and of these strands will be understood from the map which illustrates this Handbook.

In 1707, the combined waters of the Liffey and Dodder flowed across the sands at low-water, dividing them into the North Bull and the South Bull. From its exposed position, the channel thus formed was subject to constant alteration in depth and direction ; and this being the only channel by which vessels could reach the city, the early attempts to improve the harbour took the direction of providing a permanent and deep-water approach to the port. With this end in view, the Great South Wall was constructed, during the eighteenth century, to shelter the channel from southerly winds, and also to prevent the encroachment of sand.

Although the completion of the Great South Wall

accomplished to a great extent the object aimed at by its designers, portions of the channel up to the city were still very shallow; and attention was also drawn to a shoal beyond the extremity of the new wall, known as Dublin Bar. This bank stretched from the north side of the bay across the entrance to the harbour in the form of a hook. The deepest water for vessels was round the end of this hook; and across the bank, in a direct line out to sea, there was a depth of only from 5 to 6 feet at low water of spring-tides. At the beginning of the nineteenth century many eminent engineers and naval officers were consulted respecting further improvements. Captain Bligh recommended a wall along the north side of the channel; Sir Thomas Hyde Page proposed a similar wall, and the formation of an island on the Bar; while the proposal to construct an embankment or wall extending from the north shore towards Poolbeg emanated from the Corporation for preserving and improving the Port of Dublin. Mr. Rennie, at that time considered the highest authority on the improvement of harbours, prepared an elaborate scheme; but he predicted little likelihood of much improvement on the Bar. He expected an increased depth of 8 feet of water as a result of an estimated expenditure exceeding £655,000. To provide a better approach, he considered it essential to construct a ship-canal from some point on the adjacent coast where deep water might be obtained, and finally recommended the entrance to be made close to the present site of Kingstown Harbour. His estimate for this work was £489,784. From 1802 to 1812 the question of the improvement of the Bar appears to have been in abeyance. Probably Mr. Rennie's scheme, from the large expenditure it would have involved, and the smallness of the results anticipated, tended to deter the Government from advancing the necessary funds for any particular scheme.

About 1819, the Ballast Board found themselves in a position to carry out their own project of a wall or embankment from the Clontarf shore. Its object was to protect the Harbour on the north side from the encroachment of sand, to shelter it from northerly and easterly winds, and to direct the tidal and river waters in a fixed channel

across the Bar. Under the joint direction of Mr. Giles and Mr. Halpin, the engineer of the Ballast Board, the rubble embankment, known as the Great North Wall, was constructed.

It is about 9400 feet in length ; of this, about 6000 feet, from its commencement at the Dollymount shore, is constructed to a height of 6 or 7 feet above high water, the remaining 3400 feet being carried up to half tide-level only. To quote from a paper communicated by Mr. J. P. Griffith to the Institution of Civil Engineers on "The Improvement of the Bar of Dublin Harbour by Artificial Scour,"¹ it is necessary to have a general knowledge of the currents in the bay fully to appreciate the value of the Great North Wall ; "and for this purpose the most important fact to be borne in mind is, that on the north side of the bay, during the first half of the ebb, the tide runs westwards towards the Bar, and then southwards in the direction of Kingstown, while during the last half of the ebb and the whole of the flood, the tide sets eastwards past the Bailey. During the first half of the ebb, the tidal and river waters within the Great North and South Walls pass partly over the submerged portion of the northern embankment, and partly through the Harbour entrance between its termination and Poolbeg Lighthouse. The current out of the Harbour during this time is comparatively slack, and in no way interferes with the navigation of vessels in and out of the port. It is also probable that it produces little or no effect in deepening the Bar channel, but only joins the bay currents, and sets south towards Kingstown. As soon, however, as the lower portion of the northern wall is uncovered, the remainder of the tidal and river waters within the Harbour must pass through the contracted entrance at Poolbeg, which is only 1000 feet wide. The results are a great increase in the velocity of the current, which somewhat exceeds three miles per hour during spring-tides, and a marked impression on the Bar by the removal of sand. This sand-bearing stream joins the bay current, which by this time is setting eastwards, and ultimately

¹ Trans., vol. lviii., Part iv., 1878-79.

deposits on the North Bull a portion of the sand from the Bar, while the rest is carried into deep water.

"The tidal water entering on the flood comes from the south, bringing back some of that discharged on the first half of the previous ebb. It appears, however, that, except at neap-tides, but little of the water discharged during the second half of the ebb returns, in consequence of the current of the north side of the bay still setting east, and that the Harbour is thus safe from injury by the return of sand upon the flood-tide."

A deep-water channel extends from the river through the estuary in a practically straight line to the entrance at Poolbeg—a distance of five and a half miles, measured from the Custom House. The tidal portion of the river continues from this point to the Weir at Islandbridge—a distance of one and a half miles.

The South Wall runs parallel and quite close to the deep-water channel, leaving but a narrow strip of foreshore, the lower portion of which, below the old Pigeon House Harbour, is not more than 200 yards wide, and is only exposed at low spring-tides.

On the north side of the deep-water channel, a very considerable area of foreshore or slob-land exists, which is uncovered at low water. It is over a mile in width and nearly three in length.

The River Dodder joins the Liffey on its right bank, immediately above the estuary. A small river, the Tolka, flows directly on to the north-west corner of the estuary at Fairview.

The estuary within the walls, and to some distance eastwards beyond the Poolbeg and Bull Lighthouses, together with the tidal portions of the river, forms the Dublin Harbour.

New Quay Walls.

The old shipping quays were built in the early part of the nineteenth century, and were founded about low-water level. A length of about 7500 feet of these quays to the eastward of Butt Bridge has been rebuilt at a cost of

about £360,000. This enables some of the principal coasting and cross-Channel steamers to sail at fixed hours irrespective of the tide. A large portion of these reconstructed quays is on the south side of the river, and forms deep-water berths available for over-sea as well as for coasting vessels; and at the greater portion of these latter quays there is a depth of 22 feet alongside at low water.

North Quay Extension and Alexandra Basin.

New deep-water quays and a large tidal basin called the Alexandra Basin have been constructed on the north side of the river. These new quays have already added 40 per cent. to the length of the river-quays to the eastward of Butt Bridge. The quay-walls of the North Quay extension and Alexandra Basin have attracted much attention amongst engineers, owing to the manner in which they were constructed. They were built up to low-water level with gigantic blocks of masonry, each block weighing 350 tons, and over these blocks the upper portion of the walls was built by tidal work. The blocks were put together on a wharf, and when sufficiently hardened were lifted and conveyed to their destination in the quay-wall by a floating shears. The foundation for the blocks was first excavated by a steam-dredger to within 2 feet of the finished level, and the remainder of the excavation was taken out by men working in a large diving-bell, 20 feet square and 6½ feet high. Access was obtained to this chamber by a wrought-iron shaft and air-lock without lifting the bell. One of the most important features of this mode of construction is the absence of coffer-dams, staging, and pumping; and it has proved exceptionally economical. The whole of the machinery and appliances in this great work were designed by Dr. Bindon Stoney, LL.D., F.R.S., M.I.N.S.C.E., the late Chief Engineer of the Dublin Port and Docks Board. The quays on the river side of the North Quay extension afford berthingage of 22 feet at low water, while the berths along the quays inside the Alexandra Basin have a depth of 24 to 26 feet at low water. The Alexandra Basin is still unfinished.

The foregoing information on the Port of Dublin has been taken from an interesting paper which was read by Mr. John Purser Griffith, M.I.N.T.C.E., Engineer to the Dublin Port and Docks Board, at the summer meeting of the forty-fourth session of the Institution of Naval Architects, June 26th, 1903.

THE RIVER AND ESTUARY FROM A SANITARY ASPECT.

The Liffey has, in common with many of our rivers, suffered severely from the introduction of modern methods of sanitation.

In the old days, before the era of water-carried sewage, the pollution caused by the reception of the slop-water was not sufficient to create a nuisance, or to constitute a menace to the health of the inhabitants.

It was in the year 1853 that attention was first called to the injury which arose from the pollution of the Liffey due to the discharge into its waters of the sewage of the community.

The late Mr. Park Neville, City Engineer, then referred to the complaints which had been made that the matters discharged into the river from the sewers rendered its bed foul, and gave rise to noxious exhalations.

At that time the city was dependent upon the canals and upon its wells for a water-supply; but when the Vartry waterworks were completed, and the citizens began to avail themselves of the advantages of a copious supply of water, the volume of sewage which was delivered into the river was very greatly increased.

The praiseworthy efforts of the medical officer of health in enforcing the provisions of the Public Health Acts, whilst they conferred incalculable benefits upon the community, had the effect of very greatly adding to the pollution of the Liffey.

MAIN DRAINAGE OF DUBLIN.

BY W. KAYE-PARRY, M.A., M.INST.C.E.

Many schemes for the main drainage of Dublin were formulated from time to time by different engineers, and their relative merits were keenly criticized by the members of the municipal council and the citizens. The engineering difficulties attendant upon a work of this magnitude in a city so circumstanced as the capital of Ireland, although not insurmountable, were very considerable; and the vast capital outlay which any effective and complete system must involve made the Corporation hesitate for many years before finally deciding to embark upon the work. Meanwhile a great deal of valuable experience was being accumulated, derived from the costly schemes of a similar character which had been carried out in England. The Royal Commission on the Health of Dublin, which sat in 1879, focussed public attention upon the necessity for a comprehensive system of main drainage; but it was not until 1891 that any practical steps were taken to achieve the desired object.

At that time the late Right Hon. Joseph Meade, in his capacity as Lord Mayor of Dublin, was instrumental in forming a new Main Drainage Committee; and this Committee retained the services of Mr. George Chatterton, M.INST.C.E., and instructed him to advise them.

Mr. Chatterton carefully considered the various proposals which had been submitted to the Council, and eventually recommended the Corporation to embark upon the great works which have recently been brought to a successful issue. They were put into operation at the commencement of 1907.

The new system of main drainage consists of two main intercepting sewers laid respectively along the north and south banks of the river Liffey. These intercepting sewers receive the discharges from all the city sewers which formerly delivered their contents into the river.

A third intercepting sewer is now in course of construction along the sea-road from Dollymount, through Clontarf and Fairview; and by means of a system of Shone ejectors, the sewage from this low-level sewer will be

lifted and delivered into the sewer on the north bank of the river. The sewage is carried under the bed of the river from the north to the south side by means of a siphon at Eden Quay. All the city sewage is thus conducted to one point at Burgh Quay. Here the main outfall sewer commences. It is eight feet in diameter, and about two miles in length. This low-level outfall sewer terminates at the pumping-station at Ringsend. At this point the whole of the sewage is lifted by a number of powerful pumps a height of twenty-three feet.

The sewage is pumped by means of four sets of vertical triple-expansion direct-acting engines, coupled to centrifugal pumps. This plant is capable of lifting sixty millions of gallons of sewage per day.

From the pumping-station a high-level outfall-sewer, eight feet in diameter, conveys the sewage by gravitation to the purification works.

Before the sewage leaves the pumping-station it is mixed with milk of lime to act as a precipitant.

The purification works consist of a series of tanks which have been constructed on the site of the old harbour which was attached to the Pigeon House Fort, which is close to the South Wall, and about two miles above the mouth of the harbour at Poolbeg.

The sewage, with its dose of milk of lime, is conducted into a channel communicating with a series of tanks in which it is allowed to rest for a short period to facilitate the deposition of the solid matters by precipitation. The supernatant liquid is drawn off by floating arms, delivered into an effluent channel, and eventually discharged into the estuary. The sludge is swept into a culvert, through which it flows into a low-level sludge-tank. It is then pumped into a high-level tank, from which it is discharged into the sludge-steamer "Shamrock," by which it is conveyed to sea, and emptied into the Irish Channel outside the Bay of Dublin. The steamer "Shamrock," which was specially designed for this service, was built by the Dublin Dockyard Company at a cost of £11,000.

The total cost of the Main Drainage and Disposal Works has exceeded half a million sterling.

EFFECT OF THE NEW MAIN DRAINAGE ON DUBLIN HARBOUR.

BY W. E. ADENBY, D.S.C., F.I.C.

By the autumn of the present year, 1908, the harbour will, it may well be anticipated, form an extremely instructive object-lesson to those interested in the disposal of sewage by discharge into tidal water-ways.

The new outfall works of the Corporation will then have been in operation for a sufficient time to have stamped, so to speak, their influence on the bed and waters of the harbour. There can be no doubt of one great remedy which they will effect. The former foul condition of the bed and surface-waters of the river area of the harbour will have passed away. It is not quite so certain, however, what will be the result on the harbour generally of the large volumes of sewage, from which the solids have only been partially separated by treatment with small doses of lime and subsequent subsidence, which are now being discharged from an entirely new point of outfall, at all states of the tide. The effect of such discharge, for example, upon the growth of the green sewage weed, *Ulva latissima*, or sea-lettuce, during summer seasons cannot be exactly estimated. Under the old condition of things this weed grew plentifully in different parts of the harbour, especially in the shallow portions on the north side of the deep channel ; and considerable quantities were deposited by tidal action along the Clontarf foreshore during the summer. These deposits underwent a more or less rapid putrefactive decomposition, and at times became very offensive from the formation of sulphuretted hydrogen.

The effects of the discharge from the new outfall-works upon the harbour generally will, it is believed, afford valuable information as regards the question of the relative influences on the growth of this weed of solid sewage matters and of liquid sewage matters, when both are discharged into waterways the tidal currents of which are strong, as in this harbour.

If the growth in the Dublin harbour has been due to solid sewage-matters deposited on its bed, rather than to the liquid sewage-matters which were mixed with its waters, a reduction in the growth of the weed may be expected as a result of removing the greater part of the solid matters from the Dublin sewage before it is discharged from the new outfall into the harbour.

If, on the other hand, the growth of this weed has been more encouraged by the liquid sewage matters, it is to be feared that the growth will be but little reduced.

It may be pointed out that this question is of very great importance at the present time, because upon its settlement depends—as Professor Letts of Belfast has shown by his valuable and exhaustive studies of the conditions of growth, and of the nature and properties of this weed—the selection of a suitable method of purification, to which sewage must be subjected before being discharged into long and narrow tidal waters, with sluggish currents, such as Belfast Lough, where the growth of this weed has become so luxuriant that it has caused a very grave nuisance and trouble.

There is a second main-drainage outfall about three-quarters of a mile below the new Dublin outfall, and also situated close to the south wall. It is connected with the joint main-drainage system of the two townships of Rathmines and Pembroke, which is separate and distinct from the main-drainage system of Dublin. These two townships possess a joint population of 60,000. The sewage is untreated, with the exception that the heavier solids, such as gravel and road detritus, are removed from the sewage before it is discharged from the outfall by means of a system of catch-pits, built within the main sewers; and the sewage is largely diluted with sub-soil water, containing considerable quantities of nitrates. The discharge from this outfall is legally limited to the first five hours of the ebb tide. It has been in operation for the past twenty-seven years. This outfall is well worth a visit. It is exceptionally favourably situated, being only a mile above the débouchure of a well-defined river-channel into a bay where the natural currents carry everything away seaward at practically all states of the tide.

The condition of the bed and waters of the Dublin Harbour in 1890 was made the subject of a communication to the Institution of Civil Engineers, by W. Kaye-Parry, M.I.N.S.T. C.E., and W. E. Adeney, D.Sc., which was published under the title of "The Discharge of Sewage into a Tidal Estuary," in the Proceedings of that body, vol. cxlvii., Part I., 1902. A further description of the condition of the waters of the harbour will be found in Section 7B of the joint report by Drs. Letts and Adeney on "The Pollution of Estuaries and Tidal Waters," recently published by the Royal Commission on Sewage Disposal.

FISHERIES.

BY E. A. MONTMORENCY MORRIS, M.A.

In times long prior to history the coast inhabitants of Ireland utilized the products of the sea for subsistence, as may be gathered from the examination of shell-mounds frequently found close to where oysters, mussels, and cockles abound. The Christian hermits, who in the fifth and sixth centuries settled on remote islands off the coast, must have taken into account the fishing possibilities of their locations. Indeed, St. Enda of the Isles of Aran, definitely refers to the fishing in Galway Bay.

According to an interesting article by the Rev. W. S. Green, M.A., which appeared in "Ireland: Industrial and Agricultural," the Scandinavians, who for centuries prior to the Anglo-Norman conquest dwelt in Dublin and other coast towns of Ireland, carried on an over-sea trade in fish. But the earliest references to a great sea-fish trade are those dealing with the fishing off the west coast of Ireland by Spaniards in the fifteenth and sixteenth centuries. In the seventeenth century the Dutch, Swedes, and French had licences to use the Irish fisheries, and at the same time Scotch fishermen regularly caught herrings in Dublin Bay. With the opening of the nineteenth century, periods of prosperity, decline, and revival followed in rapid succession. The latter half of the eighteenth century was the great

period for bounties ; various Acts were passed for establishing them, and vessels were built rather to catch the bounties than to catch the fish. In Ireland the bounties at first given for all deep-sea fish were subsequently restricted to fish for curing. This drove the boats that used to fish for local markets on the east coast to the west of Ireland, where fish were more abundant. The Skerries, Balbriggan, and Howth fishers went round the coast of Donegal, and as far as Mayo.

The great fishing districts of Ireland are off the south and west coasts, and, in recent years, off the coast of the county of Donegal. There are herring-fisheries off Howth about July, and there are other herring-fisheries on the east coast, but they are at a distance from Dublin. Thus there is a rather good herring-fishery ground in Dundalk Bay, and another off Courtown, County Wexford. At one time this part of the Irish Sea was famous for its herrings; then for a great many years the fishery declined; but recently it has shown some promise of revival. The principal fishing-harbours in the vicinity of Dublin are—Dublin, Kingstown, Howth, Skerries, and Balbriggan. At Kingstown, Balbriggan, and Skerries there are sailing-trawlers and herring-boats of considerable size. In Dublin there were formerly over sixty large sailing-trawlers ; but the advent of steam has reduced the number of sailing-trawlers considerably, and a great deal of the industry is carried on by the large steam-trawlers, about ten in number, which make Dublin their head-quarters.

There is a haddock-fishery extending from Dundalk Bay southwards.

The greater part of the Irish Sea is a trawling-ground, and soles and plaice migrate within it according to season ; but in the Irish Sea the stock of fish, particularly of soles, is declining.

Lobsters are found in considerable numbers where the coast is rocky, especially about the Skerries, Lough Shinny, and Lambay districts ; and to a small extent a "prawn" fishery (see p. 179) is carried on.

With regard to inland fisheries, of course the great salmon-rivers of Ireland are those of the south and west ;

but in the Dublin district salmon are found in the River Liffey, as the name Leixlip implies. Trout are found in many of the rivers and streams; and the Tolka, the Liffey, the Ward River, parts of the Dodder, and Broad Meadow Water, are favourites with anglers.

POTABLE WATER SUPPLIES.

Dublin and its surrounding townships and districts are fortunate in possessing two excellent public water supplies—the Vartry and the Glenn-na-Smól. The former supplies Dublin proper and all the neighbouring townships except Rathmines, which draws its supply from the Glenn-na-Smól (Glenasmole) source.

THE VARTRY WATER SUPPLY.

BY SIR CHARLES A. CAMERON, C.B., M.D.

The gathering ground embraces 34,890 acres. It is composed of Lower Silurian and Cambrian rocks, through which granite rises above the surface at a few spots. The Vartry river rises at the base of the great Sugar-loaf Mountain in the County of Wicklow, and, flowing in a southerly direction, enters the sea at Wicklow, after a course of nearly eighteen miles. The river is dammed at Roundwood village, in a valley, and converted into an artificial lake, about 700 feet above sea-level, and about twenty-three miles from Dublin. The reservoir contains, when full, 2,400,000,000 gallons, or 200 days' supply for Dublin. The greatest depth of the reservoir is 60 feet, and its average depth is 22 feet. The Corporation have recently acquired 500 additional acres, and are about to construct another reservoir, which will contain 1,259 million gallons, or 90 days' additional supply to the city's population of 300,000. Up to the present about £832,000 has been expended on the works, and when the new reservoir is completed the cost will be close on a million.

The water is soft and of light yellow colour. It has two degrees of hardness, and contains $2\frac{1}{2}$ grains of solids

per gallon, of which 2 grains consist of mineral matters, nearly all potassium and sodium chlorides. It contains about 250 micro-organisms per cubic centimetre.

THE RATHMINES URBAN DISTRICT COUNCIL WATERWORKS AT GLENN-NA-SMÓL.

By F. P DIXON, M.I.N.S.T.C.E.

These works lie in the valley of Glenn-na-Smól (the Valley of the Thrushes), through which flows the river Dodder, together with its tributaries, the Cot and the Slade brooks, at a distance of nine miles from the General Post Office, Dublin, and seven miles from Rathmines. They were constructed in the years 1883-1887, from designs prepared by Messrs. Hassard and Tyrrell, of Westminster, for the purpose of supplying the mills situated on the river Dodder, as well as the inhabitants of the Rathmines district. The works consist of two impounding reservoirs—namely, an upper or clear-water reservoir, containing 860,000,000 gallons, the top-water level of which is 578 feet above Ordnance datum, and the lower or mill-owners' compensation reservoir, 156,000,000 gallons, with top-water 495 feet above Ordnance, together with catch-waters, gauge-basin, and duplicate measuring flumes for preferential supply to mill-owners. The reservoirs lie at the foot of Kippure (2,478 feet high), and the gathering-ground consists of an area of 4,840 acres of granite formation, covered with peat, and 8,250 acres free from peat, and partly of granitic, but principally of metamorphic and Silurian formation; and it is off the latter area that clear water is collected into the upper reservoir for drinking-purposes, the peaty water off the former area being passed by both reservoirs, partly in a constructed river-course, and partly through 27-inch pipes.

This valley is visited periodically by very heavy floods; consequently the waste-weirs have been made 200 feet in length, in order to deal with the flood water. During the construction of the works, on two occasions, for a period of nineteen hours each, the amount of 8·80 and 8·68 inches of rain was registered; and since then—on



RATHMINES WATERWORKS—THE UPPER RESERVOIR.
Kippure in the distance.



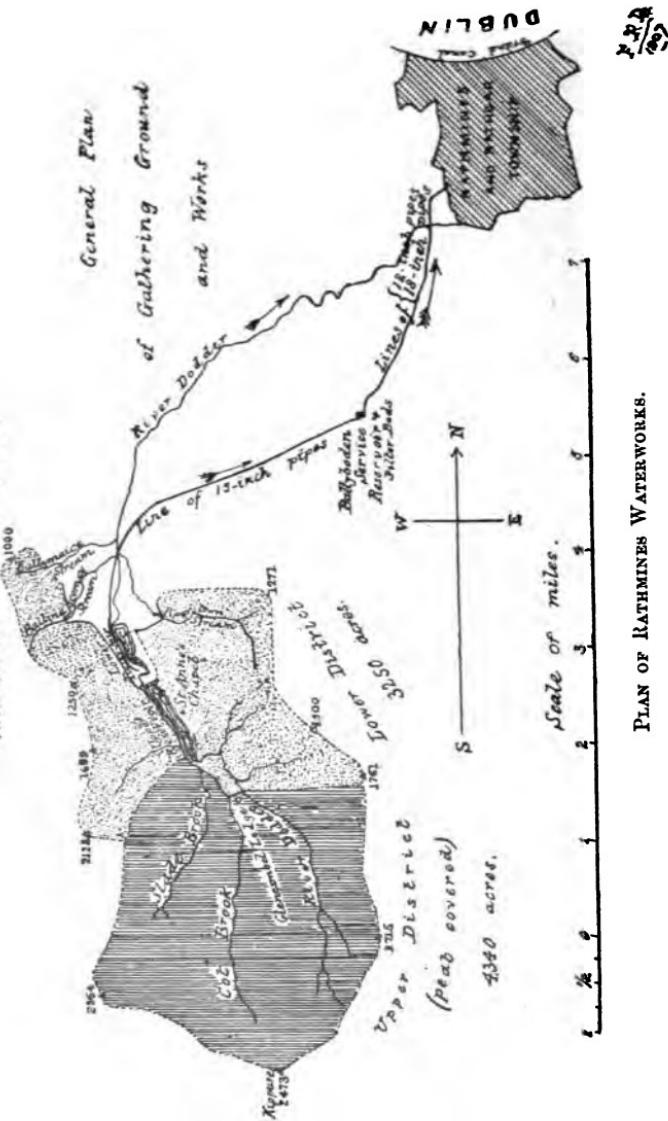
RATHMINES WATERWORKS—THE LOWER RESERVOIR.

W.M.C.

BATHMINES WATER WORKS.

PLATE XXXIV.

[To face page 393.]



August 25th, 1905 — the greatest rainfall experienced was 6·28 in $2\frac{1}{2}$ hours, of which 5 inches fell in 9 hours. On this occasion a depth of 4 feet of water was measured passing over the 200-feet waste-weir of the lower reservoir. Gauges are fixed at the head of the lower, or compensation, reservoir, so that when more than 1,500 cubic feet per minute is passing down the river-course, the surplus passes into the lower reservoir, whilst the 1,500 feet passes under the reservoir, by means of the 27-inch pipe, into the river below. Compensation water is also passed out of this reservoir into the river at the rate of 2,450,000 gallons per day for six days in the week. The works are designed also to provide 8,000,000 gallons per diem for township use. At the present date about half this amount is being used. The water can be taken off the upper reservoir at three different levels, and, after passing through a gauge-basin, is carried by a line of 15-inch pipes, $4\frac{1}{2}$ miles in length, with two relief-pits on its course, to a set of filter-beds, and then into a service reservoir holding 12,000,000 gallons, distant about $2\frac{1}{4}$ miles from the township, at an altitude of 327 feet above Ordnance, and 175 feet above the highest point of the township. From this reservoir, after passing through copper-wire gauze screens, the water is measured by passing through a Deacon meter, and is then conveyed to the township by two lines of pipes, 18-inch and 12-inch in diameter.

The filter-beds mentioned consist of two with an area of 2,000 square yards, and two with an area of 4,000 square yards, making a total of 6,000 square yards of filtering-space, capable of filtering 8,000,000 gallons per 24 hours.

The filtering material is 3 feet in depth, ranging from fine sand to 8-inch stones.

The dirty sand is washed by being put through one of "Greenway's" patent hydraulic sand-washers.

The population supplied by water is about 41,000—39,000 being in the Rathmines Township, and 2,000 outside.

The township is divided into districts, each governed by a Deacon's waste-water meter; these have proved of great use in localizing and checking waste.

ELECTRICITY.

DUBLIN CORPORATION ELECTRICITY SUPPLY.

By M. RUDDLE, M.I.C.E., M.I.E.E.

The pioneer station of the Dublin Corporation in Fleet Street was designed to supply 10,000 lamps of 8 c.-p. each in use at one time for private consumers, and eighty-one arc lamps of 2,000 c.-p. each for the illumination of some of the principal streets, and the plant comprised three sets of steam-driven single-phase alternators—each of 150 k.w. capacity—feeding into the underground distributing mains at a pressure of 2,000 volts, this pressure being reduced to 100 volts by means of separate transformers fixed in each consumer's premises. The public-street lighting was effected from three sets of steam-driven direct-current dynamos, feeding at high pressure into the eighty-one arc lamps in three circuits. The total cost of this pioneer installation amounted to £87,000.

The supply from this station was first given in September, 1892, under the Corporation's Provisional Order; and applications from consumers came in so rapidly that in the winter of 1893 additional plant had to be installed, and further additions to the generating plant were made from time to time up to 1899, when plant to the total capacity of 900 k.w. was installed in the Fleet Street station.

In 1898 the old system of house-to-house transformers was abandoned, and the general distribution to the public was given from five sub-stations, where the pressure was transformed from 2,000 volts to 200 volts and distributed at that pressure to the network of consumers' supply-mains.

As the capacity of the Fleet Street site was now exhausted, the Corporation, in view of the rapidly increasing demand, decided to provide for a large extension of the system into other parts of the city, and to erect a new generating station on the most up-to-date plans on a site which had been taken over from the War Office for the purpose of the main drainage of the city. This site, known as the Pigeon House Fort, is situated on the south

bank of the river Liffey, three and a quarter miles from the centre of the city, and possesses a small harbour which allows of colliers discharging alongside the generating station.

After much discussion it was finally decided, on the advice of Mr. Robert Hammond, the consulting engineer, to adopt the three-phase system of generation and distribution for the general lighting and power-supply to private consumers, the Corporation of Dublin being the first to adopt this system in the Three Kingdoms.

The erection of the new station was commenced in 1901 and completed in 1908, when plant to the total capacity of 3,000 k.w., and having the effective supply-capacity of 2,000 k.w., was installed, generating energy on the three-phase system at a pressure of 5,000 volts between phases. The energy is transmitted at the same pressure through three trunk-feeders to the old generating-station at Fleet Street, which has been transformed into a general distribution-station for both the old and new systems of mains. From this point the transmission is continued at 5,000 volts to twenty new sub-stations distributed about the city, where by means of static transformers it is reduced in pressure to 200 volts for lighting-purposes and 346 volts for three-phase motors.

In Fleet Street are also placed the transformers which supply the original lighting area previously fed from the single-phase generating-plant in that place. These transformers reduce the pressure from 5,000 to 2,000 volts, at which pressure it is transmitted to the five old sub-stations and is there further reduced to 200 volts for lighting and power purposes.

The public-street lighting is also controlled at Fleet Street, the direct current supply to the 490 street-lamps now installed being given by motor generators which receive three-phase energy at 5,000 volts from the switchboard, and deliver direct current to the arc lighting switchboard at an average pressure of 1,100 volts for the twenty-three circuits radiating to the different parts of the city.

The Pigeon House generating-station commenced

supplying the new system of mains in July, 1903; and the pioneer generating-plant was finally shut down in September, 1903, when the entire supply to both new and old systems of mains was given by the Pigeon House, and has since been continued without intermission.

On January 1st, 1903, the maximum demand on the Fleet Street station was 763 k.w. On January 1st, 1904, the maximum demand at the Pigeon House was 1,600 k.w.; and it became imperative to make further additions to the generating-plant at once. Further extensions of mains to new districts were also called for; and the obligations of the supply to Clontarf under the Boundaries Act having also to be met, two additional trunk-feeders were laid down between the generating-station and Fleet Street, additional sub-stations were constructed in the city area and in Clontarf, and a large additional network of distributing-mains was laid down to meet the constantly increasing demand.

The lighting of the sea-front in Clontarf is by "Flame" arc lamps, placed on poles 30 feet high, which give a most effective illumination though spaced further apart than usual.

During the past five years the cost of production has steadily decreased, and has enabled the charges to the consumers to be correspondingly reduced. These rates vary according to the class of consumer from 5d. to 3d. per unit for lighting, and from 1 $\frac{1}{2}$ d. to 1d. per unit for power-purposes.

Details of Plant at Generating-Station.

Coaling Arrangements.—Unloading by travelling grab direct from steamer into travelling conveyer, automatically weighed and delivered into coal-store and overhead bunkers. *Boiler-house.*—Four water-tube boilers, each of 10,000 lb. evaporative capacity per hour; chain grate stokers. Six Lancashire boilers (fitted with Bennis sprinkling stokers), each of normal evaporative capacity of 10,000 lb. per hour. Two of these are fitted with thermal storage vessels, increasing capacity to 14,000 lb. per hour. One Yarrow quick-steaming emergency boiler, hand-fired

and fitted with induced draft, giving an evaporation of 80,000 lb. per hour. Two sets Green's economizers. All boilers fitted with super-heaters except the Yarrow. *Engine Room*.— 2×500 k.w. sets, and $2 \times 1,000$ k.w. sets vertical compound slow-speed condensing-engines coupled direct to Oerlikon three-phase alternators. $1 \times 1,500$ k.w. set, vertical Belliss condensing-engine, coupled direct to G. E. Co. three-phase alternator. $1 \times 1,500$ k.w. set, Richardson Westgarth steam turbine direct coupled to three-phase alternator. Total plan capacity, 6,000 k.w. Supply capacity with reserve, 4,500 k.w.

Distribution Plant.—Twenty-five sub-stations, total capacity, 4,000 k.w.

Street Lighting.—506 ten-ampere direct-current arc lamps; fifty 600-watt "Flame" arc lamps; 120 fifty-c.p. "Osram" incandescent lamps. Total capital expenditure, £560,000.

Progress of Undertaking.

	1903.	1907.
Maximum load, k.w. ...	763	2,940
Consumers connected ...	850	1,580
Equivalent thirty-watt lamps	85,000	157,000
Average price received ...	5·7d.	8·3d.
Cost of generation and distribution ...	8d.	1·85d.
Total units sold ...	706,000	8,280,750
Lowest rates for power- supply	4d.	1d.

ELECTRIC GENERATING PLANT AT THE RINGSEND POWER STATION OF THE DUBLIN UNITED TRAMWAYS COMPANY.

By P. S. SHEARDOWN, M.I.E.E.

The electric generating station of the Dublin United Tramways Co. is located with the frontage on the Ringsend Road, and within a few feet of the rear of the building is the quay wall of the Grand Canal Co.'s dock. The main buildings consist of a boiler-house and engine-room placed

side by side ; the engine-room building is 182 feet long by 80 feet wide; 158 feet of this building is devoted to the machinery part of the engine-room proper; 24 feet at the rear end being devoted to stores, offices, &c.

The boiler-house is 184 feet long and 76 feet wide. Owing to the close proximity to the canal dock, an ample supply of water for condensing purposes is obtainable ; and the dock is large enough to allow 400-ton cargoes of coal to be brought alongside from the Scotch colliery ports.

The coal-handling machinery consists of a steel frame hoisting-tower, equipped with a high-pressure two-cylinder hoisting-engine, hoisting-chains, coal-shovel, &c., capable of discharging coal at the rate of 40 tons per hour. The coal is delivered from the grab to a trolley mounted on rails, where the coal is weighed. The coal-trolley then runs by gravity and discharges the coal into the outer coal store, and is returned to the coal-tower by an ingenious automatic mechanism consisting of a pivoted weight which is raised by the momentum of the car on its outward journey. The coal is conveyed from the outer coal stores to the bunkers over the boiler-house by means of a Hunt conveyer consisting of 227 buckets, which are operated by an electric motor.

The boiler-house is at present equipped with twelve Babcock and Wilcox boilers, each of 2,580 square feet heating surface, arranged in six batteries of two boilers each, three batteries being arranged on each side of the boiler-house, the batteries on the opposite sides discharging their gases into two entirely separate flues and chimneys, with separate economizers in each flue. Each boiler is equipped with a Vickers mechanical stoker, the coal being fed into the hopper by gravity from the coal-bunkers over the boiler-house, a coal-weighing mechanism being installed, so that each charge of coal can be weighed by means of the Hunt weighing-apparatus. The boilers work with a steam pressure of 155 lb. per square inch. There is space left in the boiler-house for the installation of additional boilers when required.

The engine-room at present contains six Allis's vertical cross-compound open-type engines. Four of these engines

are direct-coupled to 550-k.w. b. t. h. 550-d. c. generators. One engine is directly coupled to a 550-k.w. 2,500-volt three-phase generator at twenty-five periods. The sixth engine has direct-coupled to it both a 550-k.w. d. c. machine and a 550-k.w. a. c. machine, both these machines being mounted between the cylinders. At the present time an addition is being made to the generating equipment by the erection of a 1,000-k.w. Willans turbine, coupled to a 1,000-k.w. Westinghouse 2,500-volt alternating-current generator.

The condensing plant for the reciprocating engines consists of three Wheeler condensers mounted over compound Blake & Knowles air- and circulating-pumps. The steam on its way from the engines to the condensers is passed through baffled-type oil-separators, and, after being condensed, is passed through a Davis-Perrett electrolytic filter in order to prevent any oil finding its way into the boilers with the feed-water. The boiler feed-pumps are of the Weir and Blake & Knowles type. The new turbine will have a separate condenser of Willans & Robinson's make, the air-pump being of the Edwards type, with a centrifugal circulating-pump, each operated by a separate motor.

The Dublin system consists of the routes operating through the city and the Rathmines and Pembroke Urban Districts, the furthest terminus of which is within 4 miles of the generating-station. The whole of this area is operated by direct current; but there are two routes—one running out to Dalkey on the south side of the Bay, and 9·1 miles from Nelson's Pillar, and the other extending round the north side of the Bay to Howth, which is 9·5 miles from the Pillar, which are operated through sub-stations supplied with alternating current at 2,500 volts. The switch-board at the power-station, therefore, consists of five d. c. generating-panels with nineteen d. c. feeder-panels, and, at present, two a. c. generator-panels and five a. c. feeder cable-panels. The power-station is also equipped with two 250-k.w. rotary-converter, with the necessary switch-board apparatus to enable these to be used either for converting d. c. to alternating current or *vice versa*.

There are at present three alternating-current sub-stations—one at Blackrock, half-way between Nelson's Pillar and the Dalkey Terminus, which is equipped with three 200-k.w. rotary converters, the small sub-station at Dalkey being equipped with three rotary converters, having an output of about 200 k.w. These machines are interesting, in that they were originally d. c. generators, operated by alternating motors, forming with them motor-generator sets. These were found to be inefficient, and slip-rings were connected to the armature winding, and a very much higher output is obtained from these machines than when running previously as d. c. generators.

The Clontarf sub-station operates the distant end of the Howth and Clontarf Line, and is equipped with a 250-k.w. motor-generator set, the motor being of the induction type, operating on 2,500 volts. There are also three small rotary-converters at this sub-station, which were originally the d. c. machines of motor-generator sets.

The cables throughout the system are of the paper-insulated lead-covered type laid in cement-lined ducts.

The Company possess 880 cars, which are being added to. At the present time the electrical equipment of each car consists of two 27-h.p. motors; but the new long bogie-cars, with vestibule ends and covered tops, are each equipped with two 40-h.p. motors.

GREAT SOUTHERN AND WESTERN RAILWAY LOCOMOTIVE, CARRIAGE, AND WAGON WORKS, INCHICORE.

By HILL C. WALLACE.

Inchicore Works are situated about $1\frac{1}{2}$ miles from Kingsbridge, the Dublin Terminus of the Great Southern and Western Railway, and have been in operation since the early part of 1846, previous to the opening of the line for traffic on the 4th August of that year. They have since steadily increased in size, now covering an area of 52 acres, upon which stand about 9 acres of shop buildings. In 1847 the number of men employed was about 250; there

are now 1,600. The bulk of the rolling-stock has been constructed, and all repairs are carried out, at these works; and in addition the various articles, such as lamps, barrows, &c., required for traffic and other purposes of the railway, are made and kept in repair. The rolling-stock consists of 831 engines, 284 tenders, 908 carriages, and 7,242 wagons.

In the paint-shop all carriages, engines, and tenders are painted, a small gas-engine being used for grinding colours. Connected with this is the trimming shop, where the carriages are upholstered; here also the vacuum-brake gear is fitted and kept in repair on the carriages.

The foundry supplies all the iron and brass castings required in the shops, as well as castings for signal and other work for the Permanent Way Department. Locomotive cylinders are cast in pairs, and axle-boxes, buffer-sockets, slide-valves, &c., are machine-moulded from standard patterns.

The locomotive smithy is 282 feet long, and 50 feet wide, and contains thirty-seven fires. As much work as possible is done by stamping and welding under the steam-hammer, a large number of standard dies and tools being used for this purpose. There are five small steam-hammers in the smithy, and a 50-cwt. steam-hammer in the adjoining forge, which also contains machinery for nut-and bolt-making, screwing- and tapping-machines, spring-tester, &c.

In the boiler-shop, hydraulic riveting is as far as possible employed, a powerful machine having recently been installed for this purpose. Two electric gantries are provided.

Close by, in the power-house, a high-speed engine and dynamo supply current for driving various machines, the boiler-shop gantries, and the fans for the foundry furnaces, &c. Steam is obtained from a refuse-fired locomotive boiler. An air-compressor feeds the numerous pneumatic drills and hammers in use in the erecting- and boiler-shops.

The sawmill and joinery contain the usual wood-working machinery. The scantling for wagons and carriages,

timber for bridges, signals, and station-works, and sleepers for the permanent way, are cut here. The latter are also grooved and creosoted.

At the gas-works, both coal- and oil-gas are made. The former is used in the shops, adjoining houses, and Kingsbridge terminus; the latter lights the greater number of the coaches, and supplies over 2,000,000 cubic feet of gas during the year.

Coal required for locomotives is brought by ship to the North Wall, loaded into wagons by the company's hydraulic cranes, run to the coal gantry at Inchicore, and dropped. Iron wagons with drop bottoms, up to twenty tons' capacity, are used.

In the carriage and wagon shop, carriages and wagons are built and repaired. The hydraulic lifting arrangements for carriages are worth notice. All carriage-wheels were formerly made on Mansell's pattern, but under the newest coaches cast steel is employed.

The wagon-shop smithy is 180 feet long by 43 feet wide, and contains twenty-three fires, and three small steam-hammers. The system of stamping and welding in dies is carried out as far as possible, wagon-hinges, &c., being finished direct from the hammer, without machining in the jaws.

There are two erecting-shops, one 286 feet long and 50 feet wide, with sixteen pits; the other 326 feet long by 50 feet wide, with nineteen pits. Rope-driven gantries are provided, and a rope-driven traverser divides and serves the pits in both shops. On one side of the erecting shops are the copper-smiths' shop and testing room, and on the other the brass shop. At right angles is the fitting- and machine-shop, 324 feet long by 50 feet wide. Four automatic capstan machines are employed in making firebox stays, cylinder-belts, &c.; and a large, electrically-driven planing-machine is also noteworthy. The adjoining tool-room contains several machines for making tools, dies, &c.

All the stock is built to templates and standard sizes, care being taken to have all parts interchangeable.

The running-shed has eight pits, and accommodates forty-eight engines.

Some 142 cottages adjoin the works, occupied by the company's workmen, and a dining-hall has been provided for the use of those who live at a distance. There are also reading-rooms, billiard-rooms, library, and dispensary.

The whole of these works are under the control of R. Coey, Esq., Locomotive Engineer to the Company.

ST. JAMES'S GATE BREWERY.

The following is based on the article published in "Ireland: Industrial and Agricultural," in the year 1902, and has been brought up to date, December, 1907, through the kindness of Messrs. Arthur Guinness, Son, & Co.

GENERAL ACCOUNT.

The brewery, which is now that of Arthur Guinness, Son, & Co., Ltd., was probably founded early in the eighteenth century, and belonged to a certain Mr. Rainsford. From him it was purchased by Mr. Arthur Guinness in 1759. Up to the year 1825 the trade was almost entirely local. From 1825, however, the trade commenced to increase in Ireland and England, and about the year 1860 commenced the foreign trade, which has gradually spread to all quarters of the world.

The stout manufactured consists of four kinds, viz.: porter, which is chiefly used in Ireland for draught; extra stout, which is the article best known to the English public, but which is also largely used in Ireland; export stout, generally exported in wood; and foreign stout, which is specially brewed and stored for the requirements of the bottlers, chiefly in Dublin, Liverpool, and London, by whom it is exported.

The amount brewed is equivalent to 101,182,001 standard gallons a year, or 2 gallons per head of population in the United Kingdom; and the supply of raw materials requires the produce of 180,900 acres of barley and 1,000 acres of hops.

As regards the duty paid to the Excise, the amount

contributed by Messrs. A. Guinness, Son, & Co. in 1906 was £1,010,542, or £3,000 per working day, being more than double the amount paid by the next largest brewery in the United Kingdom, and equivalent to at least $\frac{1}{4}$ of the whole amount paid in the United Kingdom. The total number of staff and employees in 1907 was about 3,240 ; and, taking into account the families of the clerks and workmen, about 10,000 people are dependent on the brewery for their support.

As regards the materials—consisting solely of malt, hops, and water—the firm use Irish barley as far as possible, but a sufficient supply of Irish barley cannot be obtained, and, consequently, a considerable quantity has to be bought in Great Britain, and a small amount is imported from foreign countries. Like most brewers, the company make a large part of the malt they use, and the remainder required is made by various firms throughout the country, on commission, or is bought in the Irish, Scotch, and English markets. The hops are obtained from Kent and America. The third ingredient—namely, the water—is of a moderate degree of hardness, and is taken from filter-beds at the fifth and eighth locks of the Grand Canal. It contains about 80·5 per 100,000 of solids, as compared with 140–200 parts found in Burton water. The Vartry water, which forms the main supply for Dublin, is used chiefly for boilers and other purposes where a soft water is found useful ; and the water for cooling purposes is drawn from the company's own well. The total amount of water used in a year by the brewery is as much as 600,000,000 gallons.

In 1860 the premises occupied by the brewery covered about four acres ; but in proportion as its trade increased, the firm gradually acquired the ground adjacent to it in order to carry out the extensions required, so that by the present date the four acres have increased to over fifty. There are two breweries—the old and the new—the latter having been built, in 1879, as a 400-quarter plant, and subsequently extended to five times its original size—i.e., 2,000 quarters—in order to meet the exigencies of the trade.

There are three different levels in the Brewery premises,

all connected by a narrow-gauge railway. The first, or upper level, is about 60 feet above the river quay, and comprises the two breweries, the fermenting rooms, the vat-houses, the stables, and the malt and hop stores. The second, or middle level, contains the maltings, grains stores, a vat-house, and other buildings; while the third, or lower level, on the Victoria Quay, consists of the carpentry and cooperage, cask-washing sheds, racking and filling stores, as well as the platform on which the goods are loaded according to their destination on dray, boat, or railway.

The cooperage consists of three divisions, dressing-shop, making-shop, and repairing-shop, together with branding-rooms. Each cask is branded with its particular number and the name of the company before being put into trade. The number of new casks capable of being turned out is as many as 1,500 a week, and the life of each cask about ten years. Unlike other breweries, Messrs. Guinness have not adopted cask-making machinery, except for the purpose of sawing timber. The casks are practically entirely made by hand.

The firm owns 210 drays and floats, 171 horses, and 10 steamers, all in full use; and the principal railways in Ireland have connecting lines to the brewery. The steam-barges take casks from the quay which extends along the Liffey, and bring them down to the Channel steamers anchored at the North Wall, as well as to numerous vessels waiting at the mouth of the Liffey.

As regards the engineering side of the brewery, the following information may be of interest:—

Steam-Generating Plant.—The boiler installation at upper level consists of ten multi-tubular Lancashire boilers working at a pressure of 160 lb. above atmosphere and evaporating 10,000 lb. of water per hour per boiler. Each boiler is complete in itself, being fitted with mechanical stoker, fan, and motor for assisted draft, feed-pump and motor, and separate injector. A flue, common to all the boilers, runs along under the roof of the house and discharges into a steel, brick-lined chimney, 162 feet high, built on a steel gantry at the roof-level.

The boiler-house at the cooperage level is at present being extended. It contains four boilers of the same design as those on the upper level; and the extension consists of two similar boilers, but 12 inches larger in diameter than their fellows.

Electric Generating Station.—Immediately adjoining the upper boiler-house is the electric generating-station, to which steam is conveyed through a ring main. There are at present installed in the station two 500-k.w. high-pressure turbo-generators, one 250-k.w. high-pressure turbo-generator, one 250-k.w. low-pressure turbo-generator with surface condenser, all of Parsons' type, also two 120-k.w. generators, driven by high-pressure two-crank engines. All the dynamos are of the direct-current type, working at 420 volts across the outers of a three-wire system; two sets of 60-k.w. balancers, between outers and middle wire, and a switchboard, fitted on a gallery at the south end of the building, complete the station plant. The 250-k.w. low-pressure turbo is connected to a low-pressure steam system which is supplied from the exhausts of all the brewery engines. This low-pressure steam is used for heating liquors and buildings, and for other purposes, and during the summer months for drying grains. At certain seasons of the year there is a surplus back-pressure steam, and this is passed through the low-pressure turbo to a surface-condenser. Electricity is now generally used for light and power, except in some of the old buildings; the power is furnished by motors varying from one quarter to twenty-five horse-power, about 300 in number, aggregating over 1,800 horse-power. The total lighting load is equivalent to 16,000 lamps of eight-candle-power. Adjoining the electric station is the hydraulic pumping-station and accumulator.

Cooling Plant.—This plant is situated in No. 1 brewery storehouse immediately behind the electric generating-station, deals with water and brine cooling systems, and consists of two Linde ammonia compression sets of about 150 horse-power each, one carbonic acid compression set of about 40 horse-power, one ether compression set of about 40 horse-power, and one Reece's ammonia absorption

machine. The work done annually amounts to 6×10^9 British thermal units.

Heat Interchanges.—The methods for preventing the waste of heat in the different processes of manufacture are not without interest. The products of combustion in the steam-boilers on their way to the chimney pass through an interchanger and heat the air which is to be passed through the furnaces. It may be mentioned that this system has been successfully worked in the brewery since 1891.

The feed-water for the boilers is first heated through interchangers by the condensed steam which is collected in the steam-traps, and which is returned through a system of return trap-mains to the boiler-house. As already mentioned, all engines and turbines exhaust into a low-pressure system at about 10 lb. pressure above the atmosphere; this steam is used for heating and drying purposes, and is the second agent in raising temperature of feed-water.

Water which has been passed through the first section of the refrigerators used for the cooling of wort is returned to the brew-house and passed over a series of trays in which it mixes with and condenses steam from the boiling-coppers, and whence at a temperature of 210 degrees Fahrenheit it flows into scald-receiving vessels. Water also passes through the back of the copper furnaces, cooling the bridges of the furnaces, and running on through the jackets of the chimneys from these furnaces takes up heat from the gases there, and finally flows over the trays above referred to, into the scald-receiving vessels.

Coal.—The total quantity of coal used for all purposes is over 40,000 tons a year.

Railways.—A system of narrow-gauge (22-inch) railways runs through the brewery; this is equipped with steam locomotives and wagons for malt, grains, casks, &c. There are twenty locos., and about 450 wagons, bogies, &c. Malt is conveyed in covered tip-wagons, while the cask traffic is carried on with bogie wagons. There are in all $7\frac{1}{2}$ miles of narrow-gauge railway. A branch of the Great Southern and Western Railway line enters the cooperage area; and this traffic is worked by means of broad-gauge haulage wagons. A narrow-gauge loco. is

hoisted into a haulage wagon, their combined weight being about twenty tons, and the loco. driving by means of its wheels through a $4\frac{1}{2}$ to 1 gear on to the main axles of the wagon is capable of dealing with the traffic. There is about 1 mile of broad-gauge line.

In order to have easy connexion between the different levels of the brewery, two tunnels were constructed. A narrow-gauge railway proceeds through a spiral tunnel, which passes in two and a half turns under James's Gate yard level to the mid level, at which point it passes under James's Street to Cooke's Lane. An incline carries the railway from here to the low level at the cooperage. The spiral tunnel is 20 yards in radius, and with its approaches about 470 yards long; it has a grade of 1 in 40. Alongside the railway tunnel under James's Street is the passenger tunnel (a cast-iron tube), which is reached by means of a stairway at James's Gate end, and finishes at Cooke's Lane level; it is 105 yards long.

Brewery Buildings.—The brewery buildings are now generally constructed in steel, the latest example of this being the new fermenting house in Market Street. This is 125 feet high, 170 feet long, and 151 feet wide; and the weight of the structural steel is about 8,650 tons.

The No. 2 Brewery is another example of steel construction.

Telephones.—An extensive system of telephones is installed throughout the brewery. There are at present over 280 instruments of all kinds; about 100 of these are on the National Telephone system, and connected through a sub-exchange in the brewery premises with the city exchange.

Fire Appliances.—At St. James's Gate level three sets of fire-engines work at a pressure of 100 lb. per square inch, and are connected to a system of fire-mains; this system is also used for washing purposes, so that the fire-engines are working continuously, night and day, and always available in case of fire. Two main fire-stations are provided, one at James's Gate level, and one at cooperage level. Fixed hydrants and hose are in readiness throughout the buildings, and ordinary ground-hydrants in the yards.

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AN IRISH POT-STILL DISTILLERY.

SCIENTIFIC WORK.

Turning now to the scientific work carried on by the company in the two large laboratories attached to the brewery, one of which is chiefly devoted to analytical, and the other to research work ; as a matter of routine every parcel of barley and malt coming into the brewery is analysed, a large portion of the hops is tested, and all materials are carefully examined for purity.

On the research side numerous problems have been attacked, and research on various chemical and biological lines is a permanent branch of brewery routine.

The scientific work of the brewery comprises experiments with a view to improving the cultivation of barley in Ireland, which have been undertaken in collaboration with the Department of Agriculture, a number of plots being distributed throughout the country.

The brewery is provided with an experimental malt-house and an experimental brewery ; and in addition to other experiments these establishments malt and brew the produce of the experimental plots. The experimental brewery and malt-house have been adjusted to the size of the plots, and admit of about five quarters of barley being dealt with.

An experimental hop farm is also being worked in connexion with the scientific aspect of the brewery.

THE DISTILLING INDUSTRY.

By E. A. MONTMORENCY MORRIS, M.A.

The distilling industry has now reached enormous dimensions in the United Kingdom, and it is one of the chief Irish industries. It is, however, only in comparatively recent times that distilling has attained to its present importance, although the art of separating alcoholic spirit from fermented liquors appears to have been known in the Far East from remote antiquity. Gradually a knowledge of the art travelled westward, and the word

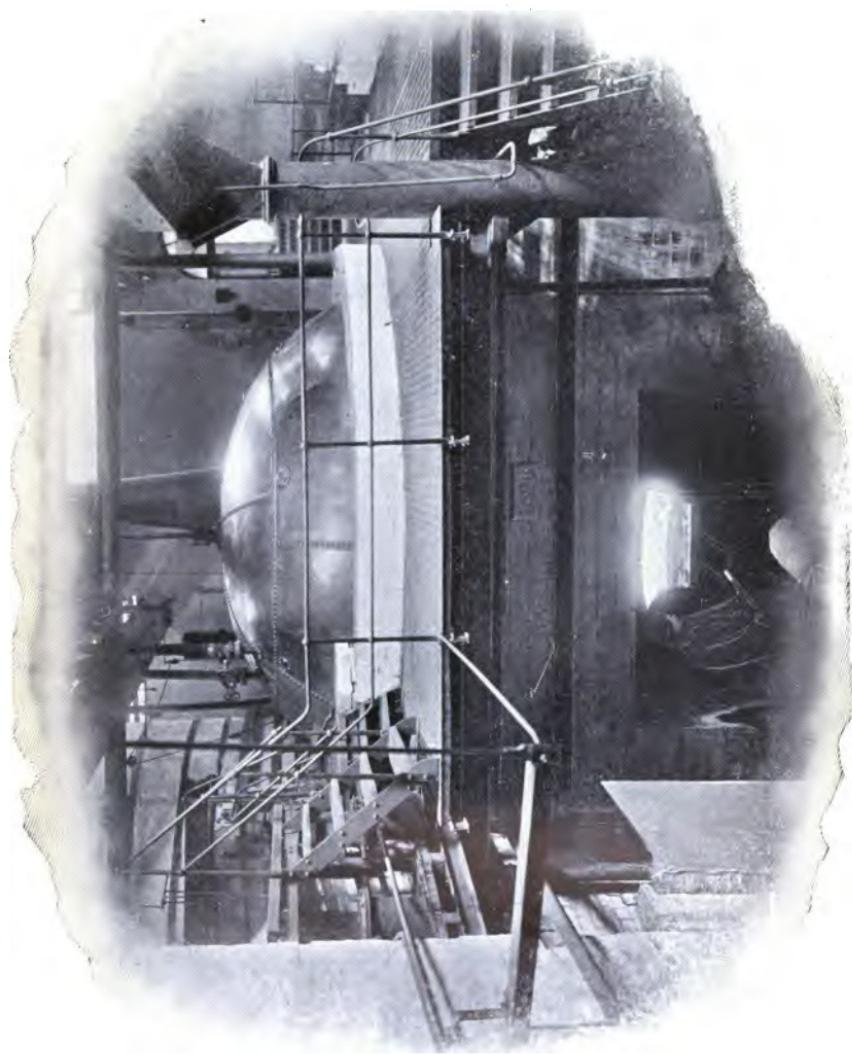
alcohol is supposed to indicate that a knowledge of the method of preparing alcoholic spirit came to western Europe, like much other chemical learning, through the Arabs. It was, however, left to a Frenchman, Arnauld de Villeneuve, a physician of the thirteenth century, to first write an explicit account of the intoxicating spirit obtained by the distillation of wine. He mentions it as a recent discovery, and considers it to be the universal panacea so long sought after in vain.

France was for some time the seat of the distilling industry of Europe, as her grapes afforded a constant supply of material for the distillation of brandy; but as grain became more plentiful, the industry of distilling spirits from corn developed in northern Europe.

It seems to be admitted that distilling was practised in Ireland at a period earlier than in Great Britain, or in any other part of north-western Europe. When Henry II, in the twelfth century, invaded Ireland, the people were observed to be in the habit of making and using a kind of alcoholic liquor called usquebaugh (*water of life*)—a term which is synonymous with the classical *aqua vitae*. A description of the virtues of usquebaugh and a recipe for making it are contained in the Red Book of Ossory; and it is known that the Irish were in the habit of distilling spirits from malt. The word “whiskey” is a corruption of usquebaugh. Dr. Johnson, in his famous dictionary, states that this word is “Irish or Erse word which signifies the water of life. It is a compounded, distilled spirit being drawn of aromatiks, and the Irish sort is particularly distinguished for its pleasant and mild flavour. The Highland sort is somewhat heavier, and by a corruption in Scotch they call it whiskey.”

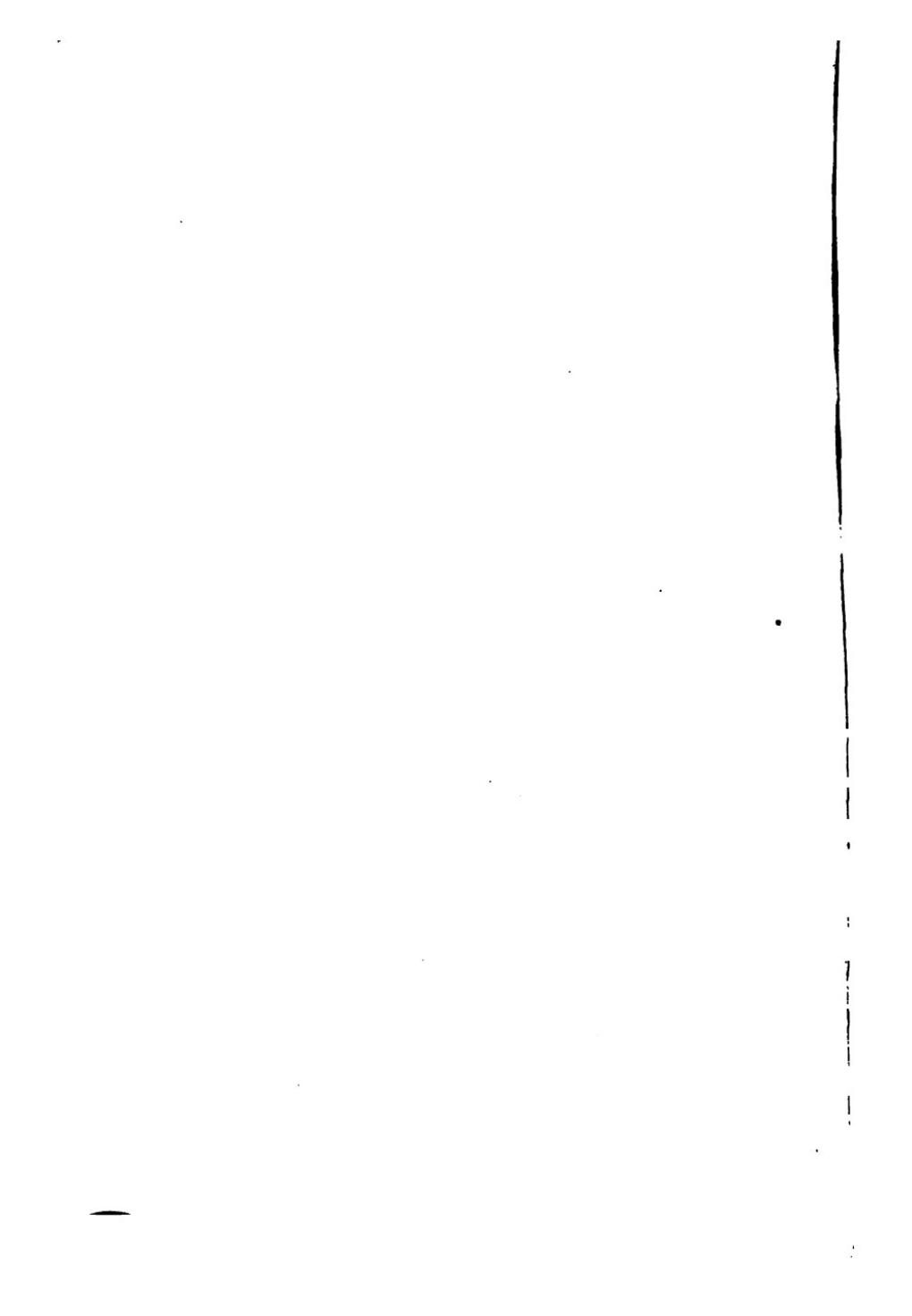
Even before the reign of Elizabeth the Irish distilling industry had assumed considerable proportions, and restrictions had at various times been imposed upon the manufacture and sale of spirits.

A statute was passed at Drogheda, in 1556, restricting the manufacture of whiskey—“a drink nothing profitable to be daily used and now universally made throughout this Realm, especially on the borders of the Irishry, whereby



AN IRISH POT-STILL.

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much corn, grain, and other things are consumed." By the end of the sixteenth century many licensed distillers existed; and persons were nominated in each province who had the sole power of granting licences.

The industry of distilling spirits from grain had, even before the reign of Charles II, assumed proportions sufficiently great to make spirits productive of revenue; and after the Restoration in 1660, a permanent tax was imposed upon every gallon distilled.

A number of the most important distilleries in Ireland were started in the latter half of the eighteenth century. The Bushmills Distillery is said to be the oldest in Ireland, as in the year 1748 it was being worked by a band of smugglers, but in 1784 it was recognized as a legitimate distillery making about sixteen thousand gallons of whiskey per annum. A number of other distilleries were established about this time: thus the Brusna Distillery, Kilbeggan, was founded about 1750; the Thomas Street Distillery in Dublin was purchased by Mr. Peter Rowe in 1757, and the North Mall Distillery, in Cork, was erected by Mr. Wyse in 1778; whilst in Dublin the Bow Street Distillery, the John's Lane Distillery, and the Marrowbone Lane Distillery were all started before the end of the century. There can be no doubt that towards the end of the eighteenth century the distilling industry flourished exceedingly in Ireland, and the consumption of spirits so increased as to attract the attention of the Irish Parliament, which endeavoured to check the activity of the distillers by encouraging the brewing industry.

The nature and conditions of the Irish distilling industry have greatly changed since pre-Union times. The changes in the duty and regulations enforced by the Inland Revenue authorities have had a marked influence upon the fortunes of distilling, and the same forces that brought industrialization in many industries have had their effect upon distillers also. Many of the smaller establishments have ceased working, but the larger distilleries have enormously increased their output. The amount of spirits distilled is now three times as great as the quantity produced a century ago, though the number of distilleries at present

working is less than one-third of the number at work at the beginning of the nineteenth century.

There are now about thirty distilleries in Ireland, but some of these are mainly blending establishments. Consideration of space prevents mention being made of each distillery in Ireland; but a few words as to the date of foundation and situation of the more important Dublin distilleries may not be out of place. The best known distilleries in Dublin are those of John Jameson & Son, Ltd.; John Power & Son, Ltd.; The Dublin Distillers Co., Ltd.; The Distillers Co. (Phoenix Park Distillery); and the Dublin City Distillery Co. The two first-mentioned distilleries, viz., the Bow Street Distillery, owned by Messrs. John Jameson & Son, and the John's Lane Distillery, owned by Messrs. John Power & Son, date back to 1780 and 1791 respectively, and are both exclusively pot-still establishments. The Dublin Distillers Co. was formed by the amalgamation of three distinct distilleries, the Thomas Street Distillery, Marrowbone Lane Distillery, and the Dublin Whiskey Distillery, at Jones's Road. As already mentioned, the first two of these distilleries were erected in the eighteenth century, whilst the Jones's Road Distillery is quite modern, having been started as late as 1872.

Some idea of the extent of the distilling industry may be obtained from the Revenue Returns. It appears from these that over 14,000,000 gallons of whiskey are distilled annually. Of this quantity nearly 8,000,000 gallons valued at £2,140,500 are exported.

THE IRISH POPLIN INDUSTRY.

BY E. A. MONTMORENCY MORRIS, M.A.

The early history of poplin-making is unknown; indeed, the origin of the name itself is doubtful. For while some derive it from an old French verb, *se popiner*, "to deck oneself out," others associate the name with the town of Poperingen, where they say poplin was first made. Others again assert that the word comes from *Papeline*, which

name they say was given to a fabric of much the same character made at Avignon during the residence of the Popes in that city. In Ireland, however, its history presents few difficulties. Like linen-making and silk-weaving, it owes its origin here to the Edict of Nantes. Many Huguenots settled in Dublin; and in the year 1698 we hear of poplin-making in the "Liberties," which, as is well known, was at one time an important part of the city, but which, when the refugees took up their residence there, was already falling into decay. Such, however, was the energy of the Huguenots that the district became a hive of industry, and was soon too small for its inhabitants. New streets were built; and Spitalfields, the Coombe, Pimlico, and Weavers' Square were crowded with silk- and poplin-makers. As the names of the localities would suggest, many of the weavers came from England—where they had at first settled—because of the greater prosperity of the silk and poplin industry in Ireland. The poplin trade increased by leaps and bounds, and the "Liberties" and its surroundings became one of the most prosperous parts of the city.

In the year 1800 the invention of the Jacquard loom revolutionized the silk industry, and did much also to help poplin-making. At this time, however, the heavy import duty on the raw material was a great drawback to the trade. The duty was 7s. 7d. a pound on foreign "thrown silk," 4s. on raw Bengal silk, and 8s. 6d. a pound on all other kinds of raw silk. In 1826 this duty was much lessened; but it still affected the industry very adversely by encouraging the smuggling of foreign goods. When the duty was lessened, the firm of R. Atkinson & Co.—formed in 1820—seized the favourable moment; and as the fashion of the time favoured rich brocade dresses, for the making of which poplin is singularly suitable, they soon, by their enterprise, achieved a leading position. Constantly introducing new varieties of silk, fine woollen yarns for wefts, and ever studying new shades, textures, and designs, they took a leading place in the production of this artistic Irish material.

It may be mentioned here that the handloom (much

improved, of course) is still used in their new factory, as they find it best adapted to the production of their rich goods.

Poplin is a fabric composed of worsted made from the finest description of wool and silk in combination. The fabric is so woven that the surface is altogether pure silk, while firmness is given to the material by the wool in the interior. Poplin is of three kinds—single, double, and “terry.” The first two are so alike that few can tell them apart, the difference being in the quality of the silk used in the warp. The third is corded, and is the kind that is most generally associated with the idea of Irish poplin. The various processes of making require great skill and watchfulness, which is perhaps one of the reasons for some of the peculiar customs which still exist amongst poplin workers. For instance, while most industries are open to all who wish to engage in them, the Dublin poplin-makers refuse to allow anyone who has not served a seven years' apprenticeship, or who is not the eldest son of a poplin-maker, to work as a poplin-weaver.

Though most of the silk used in poplin-making is of foreign manufacture, the Dublin weavers succeed in treating it in such a way as to make Irish poplin a distinct fabric. Indeed, though poplin is made both in France and at Norwich, no makers but the Irish seem to be able to produce the softness of texture and brilliance of colouring that are so characteristic of the best poplin. The beauty of the colour of Irish poplin has been attributed by some to a peculiarity of the Dublin water; but it is much more likely that it is due to the knowledge and skill of the Irish maker. Though poplin was at first almost exclusively made in the homes of the workers, and though even still home weaving exists to some extent, most of the poplin is made in factories. The principal factories are those of Messrs. Atkinson, Pim, Fry, and Elliott. Both Messrs. Pim and Messrs. Atkinson are large manufacturers.

Though almost everyone admires poplin, the trade cannot be said at present to be a very large one. Many people consider poplin very expensive; but it should be remembered that it is almost everlasting, and in this sense is

highly economical. Black poplin is excellent for mourning, the dark shades being more intense than those produced in silk. It must, of course, be acknowledged that poplin cannot, from the peculiar nature of the material, be so variously treated in the matter of pattern and range of ornament as silk can; nor can all the varied "fabric effects" of modern silk-weaving, foulards, &c., be obtained in poplin. None the less it is very beautiful material, everlasting in wear, and really cheap.

THE IRISH ART COMPANIONS.

BY E. A. MONTMORENCY MORRIS, M.A.

There is one Irish policy about which everybody is agreed, namely, the development of Irish industries; and this is the policy of the Irish Art Companions. In 1904 they set to work, taking a house, a workshop, and show-room at Nos. 27 and 28 Clare Street, Dublin. They saw tens of thousands of pounds going each year from Ireland to France and Germany for ecclesiastical statuary—Irish money going away to buy foreign material, to subsidize foreign art education, to pay the wages of workmen, and to swell the traffic returns of foreign ships and railways, whilst at home there were excellent brains and hands starving for want of encouragement.

Ireland in the eighteenth century was celebrated for her plaster-work. The ceilings and cornices of many of the city and country mansions testify to its excellence. But the last plaster-maker in Dublin disappeared from the Dublin Directory after 1864; and from that time until the establishment of the Irish Art Companions little plaster-making, if any, was carried on in Dublin. Now the Irish Art Companions make their own plaster from local gypsum. This plaster they cast into sacred or secular statuary, bronzing or tinting the statues to suit the tastes of their clients.

Some of their models are from fine old Italian works of art, such as the great life-sized crucifix made by the

Companions for Westminster Cathedral. This is a replica of the bronzed crucifix by Donatello over the high altar at Padua.

Others are the works of local artists, notably Mr. Joseph M. Carré, Mrs. Vanston, and Miss Gwendolen Herbert.

Besides the crafts of modelling and casting, the Companions make rosary-beads and other articles from horn; and for this purpose they have allied with themselves Mr. Albert Mitchell, the son of the last of many Irish by-gone comb-makers. It is a matter of regret to think that in Dublin alone, about the year 1820, there were some 700 comb-workers, whilst there are very few now. The efforts of the Companions have done something to revive this industry; and the future of the trade is in the hands of the Irish people themselves.

Another department of the work of the Art Companions which calls for notice is their large show-room in Clare Street. This is not only an ordinary shop, in which they keep their own productions for sale, but it is a free market for workers all over the country. Into this dépôt any worker may bring lace, crochet, embroidery, home-spuns, wood-work, or metal-work, and place the objects on exhibition absolutely free of all charge, only a small percentage being charged in the case of sale, to pay rent and maintenance. In this way many small workers and struggling industries have been helped, and fair prices obtained.

The Companions also deal with English customers, and organize sales in private houses all over England, as well as sending goods to English bazaars.

BISCUIT-MAKING IN DUBLIN.

BY E. A. MONTMORENCY MORRIS, M.A.

In the year 1851 the late Mr. William B. Jacob decided to add the manufacture of biscuits to an already extensive bread bakery and flour mill in Waterford. The success of the undertaking resulted in a few years in the transfer of

the business to Dublin, and the concentration of all the energies of the firm upon the development of the biscuit trade.

The building up of the industry entailed not alone the training of a complete staff of workers, but the continual addition of new plant and the improvement of that already in use.

The leading aims from the beginning were to make quality the first consideration, to keep the factory up-to-date by purchasing the most improved machinery, and to cultivate a spirit of harmony amongst the workers.

Extensive dépôts have been specially built in London, Liverpool, and Manchester, so as to ensure the prompt delivery of the goods throughout England. During the past few years, too, the firm have given much attention to the development of the foreign trade.

In many ways the organization of the factory shows unusual care. On every floor are laid the rails of a tiny tram-line. Up and down are wheeled miniature waggons which convey the biscuits and tins from one department to another until they are finally placed in the large stock-rooms. In the last of these rooms there are arrangements for packing the biscuits into " skips " for conveyance to the various dépôts. These " skips," which hold a very large number of tins, resemble small furniture vans, and they are so constructed that they can be easily lifted by derricks placed on the lorries, and then despatched by steamer or rail to their various destinations.

The manufacture of rich cakes forms an important element in the work of the factory.

A tour of the factory would be incomplete without a visit to the power-houses, from which is derived an available motive-force of 1,000 h. p., for the greater part electric.

The department for making tins is quite a factory in itself: rows of intricate machines are to be seen by which the workers are enabled deftly and rapidly to convert sheets of tin into neatly finished boxes ready for packing.

In the employment of this firm there are more than 2,000 persons. Of these a large number are young women

and girls. Dining-rooms worked on the most healthy and economic lines are provided. For instance, in one of their large buildings the whole of the top floor forms a huge dining-room capable of seating 500 girls. In this dining-room books, magazines, and a piano are provided; and over the dining-room is a flat-roofed garden where in fine weather the girls can enjoy fresh air.

In connexion with the workers there is a large choral society, which meets in the buildings after working hours for practice under an able musical conductor. Last year three choirs of these workers competed in the Feis Ceoil—the Irish National Musical Festival—and they won the first and second prizes in the section for working choirs. There is a drill class for girls held during the winter months, and it is largely attended. The firm pays the fees for a number of its employés at the City Technical Schools in connexion with classes for certain trades, and also for teaching sewing, cooking, &c.

There is a St. John Ambulance Association brigade, in which both men and girls are instructed in "first aid to the injured."

MANUFACTURE OF AERATED WATERS.

By E. A. MONTMORENCY MORRIS, M.A.

Ireland has long been celebrated for the richness and purity of its mineral-water resources. This, no doubt, is due to the recommendations of the product of the Irish springs by medical specialists. There are several aerated-water manufacturers in Dublin; but a short account of Messrs. Cantrell & Cochrane's business must stand for all. The foundation of this firm was laid in Belfast in 1852 by Dr. Cantrell, who subsequently was joined in partnership by the late Sir Henry Cochrane. For many years the output of this firm held a monopoly in Ireland.

It is said that Messrs. Cantrell & Cochrane have on the site of their premises in Dublin "St. Patrick's Well," the waters of which in olden times were supposed to possess the most extraordinary curative properties.

Nassau Street and Nassau Place, where the works are situated, derive their names from one of the sub-titles of William III. Before his coming Nassau Street was known as "St. Patrick's Well Lane," because it led to the famous holy well of the national saint.

Besides the firm's works in Dublin and Belfast, they have depots in London, Liverpool, and Glasgow, and numerous agencies throughout the United Kingdom.

PRINTING.

By E. A. MONTMORENCY MORRIS, M.A.

The printing and paper trades have always been important in Dublin, and at present they constitute a considerable industry. The more notable printing firms are Messrs. Alexander Thom & Co., Messrs. James Walker & Co., Messrs. Cherry and Smalldridge, and Messrs. Hely, Ltd.

The old firm of Messrs. Alexander Thom & Co. was established in 1824 by Alexander Thom, and has grown to be one of the largest businesses in Dublin, and it now employs hundreds of hands. Mr. Thom held the position, by Letters Patent, of Queen's Printer, and editor, printer, and publisher of the *Dublin Gazette*, the official publication of the Irish Government. Letters Patent were also granted to his successors. In 1887 the firm was converted into a limited company; and in 1890 it was reconstructed so as to include the firms of Sealy, Bryers, & Walker, and Sullivan Brothers. The former of these houses has made a considerable reputation as publishers of Irish books; while Sullivan Brothers are the publishers of a well-known series of high-class school books.

The encouragement afforded to artists by the lithographic method of faithfully reproducing their work for the public, had a wonderful effect in creating changes in design, and in evolving a more effective display than was possible with the old colour prints.

The practical adoption of lithography for colour work only commenced in the year 1865 with the invention of the

"Huguet" lithographic machine. Messrs. James Walker & Co., of the Jones's Road Colour-Printing Works, were amongst the first half-dozen colour-printers who introduced these machines into the United Kingdom, and the firm was the pioneer in Ireland of the colour-printing industry. Since 1865 there have been many changes in the machinery used, though the bulk of colour-printing is still produced by the lithographic process. The latest lithographic machines are what are known as the aluminium rotary machines. These machines embody in their structure the last words in mechanical progress. Under the old system each print was passed by a cylinder over a flat stone—a process which entailed a complete forward and backward traverse of the stone for every sheet run through. In the new rotary machine the metal plate which takes the place of the stone is bent round a cylinder, and in each rotary motion of the latter a print is made.

The name of Helys, Ltd., is perhaps most often associated in the public mind with the retail stationery business, and not unnaturally so, for the large warerooms in Dame Street, where this business is carried on, are perfect hives of industry. But though the public is most familiar with the retail side of the business, it is the wholesale and manufacturing side that forms the backbone of the firm's trade. Helys, Ltd., produce large quantities of commercial stationery, bill-heads, ledgers, and works of this kind, aided by the latest American labour-saving equipment.

The scientific printing done in Dublin is to a considerable extent the work of the Dublin University Press (Ponsonby & Gibbs), who turn out the publications of the Royal Irish Academy, Royal Dublin Society, Royal Society of Antiquaries, and many scientific text-books. Their work includes much printing in the Irish, Greek, and other characters, and also mathematical work of great intricacy, contracted Latin and Old English, and other printing requiring high technical skill.

GREENVILLE TOBACCO FACTORY.

By MARCUS GOODBODY.

Messrs. T. P. & R. Goodbody commenced the manufacture of tobacco in the form of what is now known as "Irish Roll" during the year 1848, at their factory in Tullamore, King's County.

The original "Roll" was manufactured right through by hand-labour. The tobacco leaf was moistened by hand, and prepared for working much in the same manner as at the present time; but the spinning machine consisted of a long table with a wooden bobbin fixed at one end. This bobbin was made to revolve by hand; a rope of tobacco being formed and rolled into shape by the operating spinner, with two assistants to hand the wrapper and filler. At a later date labour-saving machines were put on the market, which enabled one spinner with the same number of assistants to turn out nearly fifteen times the quantity in the same time.

The manufacture of "Primrose Cigarettes" was commenced in the year 1882. This cigarette appears to have been the first manufactured in Ireland, and till the advent of the 3d. packet of machine-made cigarettes was the leading brand; even at the present day it commands a considerable sale.

In 1886 the factory at Tullamore, except the snuff factory and offices, was burnt down; and the firm transferred the operations which had been carried on in the destroyed portions of their old factory to the one now at work at Greenville, Dublin.

In 1898 it was decided to extend the manufacture of cigarettes by hand; the old system of table-rolling being superseded by the push method, the latter method being much quicker, besides turning out a cleaner cigarette, as very little paste is used in making the papers.

Another extension was in the direction of cigar-manufacture. In 1891 the firm of John Garnett & Co., cigar-manufacturers, Manchester, was taken over; the cigar-

makers and all accessories to the trade being transferred to Greenville, where cigar-making in Ireland was for the first time brought to a successful issue.

The first process in the manufacture of roll tobacco takes place in a large room known as the casing-room. Here the leaf is opened from the hogsheads, shaken up and moistened, in order to allow of the leaf being handled. This process is known as "casing." The leaf passes from the casing- to the stripping-room, where the large stalk is removed from the centre of the leaf. It is next conveyed to the spinning-room, where some twenty spinning-machines form the leaf into ropes of tobacco, and coil them on bobbins. These bobbins when full are passed on to the turning-off room. Here the rope of tobacco is uncoiled from the bobbins, and formed on a machine into the shape of a roll, fastened together with pegs and reeds. In this state it is wrapped in cloths and sent to the cording-room, where a steel-cored rope is wound round the outside of the roll to prevent it from losing its shape when under pressure.

Plug tobacco is manufactured in a different way; each stick of plug being pressed in a special moulding-machine to a certain shape, after which it gets a leaf-wrapper right round, and a number of bars are placed between plates in a large press. The pressing-floor has an area of almost 3,800 square feet; it contains six finishing presses, in which the plug tobacco is subjected to a pressure of two tons, and also thirty roll-presses, each with a capacity of ninety-six rolls.

Leaving the hard-pressed tobacco department, we pass to the fancy tobacco cutting-room, where the brighter classes of leaf are all dealt with, mixtures blended and flakes pressed. The different tobaccos are cut by power-machines, which can be regulated to some twenty different cuts.

The cigarette and cigar rooms have seating accommodation for some 220 girls.

THE FERTILIZER INDUSTRY.

BY JOSEPH MILNE.

As might be expected in a country so largely dependent upon agriculture, the manufacture of fertilizers is an important industry in Dublin. The factories of W. & H. M. Goulding, Ltd., and Morgan Mooney & Co., Ltd., are among the largest in the United Kingdom. There are also the Dublin and Wicklow Manure Co., Ltd., Paul & Vincent, and Richardson & Fletcher, turning out per annum an aggregate of 100,000 tons of chemical manures.

Bones, bruised or broken, were probably the first artificial manure used; but about the beginning of the nineteenth century it was found that fineness of division rendered bones more easily assimilated by plants. This fine division was chemically attained when Liebig introduced the treatment of ground bones with sulphuric acid.

Large quantities of bones collected throughout Ireland, after having their valuable grease extracted, are ground and dissolved by sulphuric acid, and sold as bone-manures. But the supply of bones falls far short of the requirements of modern agriculture; and the enormous deposits of tribasic phosphate of lime in the United States and Northern Africa, though of little value as manure in their natural state, are converted into superphosphate by the action of sulphuric acid, whereby the tricalcic phosphate, which is insoluble, is converted into mono-calcic phosphate, which is soluble, and therefore readily available to plants.

Upon this conversion from the insoluble form to a soluble state has been built up this chemical industry, which, in these factories, transforms upwards of 50,000 tons of raw phosphates into available plant-foods.

The demand for these fertilizers in Ireland has grown rapidly within the last few years, largely owing to the work of the Department of Agriculture and Technical Instruction in instituting, through County Councils and under the supervision of their instructors, a series of experimental

plots throughout Ireland, showing the beneficial results obtainable by their use, by increasing the yield to a value far in excess of the actual cost of the fertilizers employed.

In these experiments, confirmed now by several years' experience, it has been shown that the application to meadow hay of superphosphate, nitrogen compounds, and potash means an increased crop equal to a profit of about £1 per acre after deducting the cost of the manure.

Similarly in the case of the potato crop, so largely grown in Ireland, it has been clearly shown that, on land growing an average crop of 3 tons 12 cwt. per acre without manures, the yield can be increased to over 10 tons per acre at a cost of about £4 15s. for manures, giving an estimated profit, after paying for the manures, of £8 10s. per statute acre.

In the growth of oats and barley a profit of 30s. per acre is shown from the use of these chemical fertilizers. In mangolds there is a gain of £6 10s. per acre; in turnips a yield of 25 tons per acre can be secured, as against $4\frac{1}{2}$ tons without manure.

The increased crops which the soil of Ireland may be made to yield under proper cultivation, and with the liberal use of these fertilizers, can scarcely be realized. The consumption of artificial manures is growing year by year, and is only limited by the ability of the farmer to purchase them. The Irish farmer, as a general rule, unfortunately labours under the disadvantage of insufficient capital to enable him to cultivate his land intensively, and to obtain maximum crops; but signs are not wanting that, under the guidance of the Department, Irish agriculture will rapidly advance, and in that advance not the least of the contributing forces will be the assistance rendered by the increased and intelligent use of fertilizers such as are produced at these factories. The factories themselves are equipped with all modern improvements. The basis of the business—the manufacture of sulphuric acid—is carried on on a large scale, about 1,000 tons of sulphuric acid being produced weekly. The acid plants at these works are thoroughly up-to-date, and well worth a visit by anyone interested.

The acid is produced from pyrites imported from Spain, the residue, after burning off the sulphur, being reshipped to England, where the copper contained in the cinders is extracted.

The phosphate of lime, which arrives from Africa and America in cargoes of 4,000 tons or upwards, is ground in specially constructed mills to an impalpable powder before being treated and dissolved by the action of sulphuric acid. The resulting mass after maturing is withdrawn from the dissolving-pits and pulverized to a fine powder, either for application to the land by itself, or in conjunction with nitrogen compounds and potash, which are mixed with the superphosphates by the manufacturers in the proportions which experiment and experience have proved to be most efficacious for the different crops for which they are intended.

The fertilizer industry in Dublin employs upwards of 1,000 men; while other similar factories in Belfast, Cork, Drogheda, Londonderry, and Waterford give employment to an equal number of workmen.

The importance of this fertilizer industry to Dublin, and to the country at large, is not, perhaps, realized as fully as it deserves; and a visit to one of these extensive factories will prove a revelation as to the extent and importance of these great factories engaged in the preparation of the food of plants.

IMPORTS AND EXPORTS OF DUBLIN.

By E. A. MONTMORENCY MORRIS, M.A., M.R.I.A.

In a limited space it is impossible to go fully into the details of the trades and industries carried on in Dublin and its vicinity. Dublin has been for many centuries a chief port and distributing centre for the whole of Ireland; and the following statement, based on the figures in the "Report on the Trade in Imports and Exports at Irish

Ports" (Cd. 4126, 1908), will give some idea of the importance and variety of the trade of Dublin:—

IMPORTS.

<i>Commodity.</i>	<i>Quantity.</i>
Ales	85,898 brls.
Candles	27,710 cwts.
Cement	40,957 tons.
Chemicals, drugs, &c.	194,886 cwts.
China, earthenware, and raw materials therefor	507,904 "
Coal	1,105,881 tons.
Cocoa	1,888,992 lb.
Fish	105,495 cwts.
Foreign spirits	241,286 gallons.
Fruits and vegetables	460,494 cwts.
Glass and glassware	181,829 "
Grain, flour, and feeding-stuffs ...	6,896,582 "
Hides, skins, and leather, including boots and shoes	120,515 "
Machinery	5,847 tons.
Meat, including bacon	547,491 cwts.
Oils, including petroleum and paraffin ...	10,000,000 gallons.
Paper and printed matter	886,245 cwts.
Seeds, including flax seed	83,728 "
Soap	41,665 "
Sugar, and manufactures thereof ...	765,044 "
Textile goods, including drapery and apparel	412,953 "
Tobacco	2,945,495 lb.
Wine	848,184 gallons.
Wood, timber, and manufactures thereof	105,000 tons.

EXPORTS.

<i>Commodity.</i>	<i>Quantity.</i>
Animals, including horses	893,588
Eggs	1,992,078 gt. hds.
Fish	170,353 cwts.

EXPORTS—continued.

<i>Commodity.</i>	<i>Quantity.</i>
Grain, flour, and feeding-stuffs ...	895,186 cwts.
Hides, skins, leather, and manufactures thereof ...	98,485 "
Meat, including bacon, poultry, and game ...	814,458 "
Paper and printed matter ...	69,877 "
Porter ...	555,110 hhd.
Textiles and textile materials ...	143,612 cwt.
Tobacco ...	491,187 lb.
Whiskey, etc. ...	1,987,867 gals.
Wood, timber, and manufactures thereof	48,835 tons.
Yeast ...	27,540 cwt.

AGRICULTURE.

AGRICULTURE IN THE DUBLIN DISTRICT.

BY PROFESSOR JAMES WILSON, M.A., B.Sc.

The agriculture of Dublin and the counties around it is determined mainly by their geographical position and by the agricultural policy of the country as a whole. Just as every large town is encircled by dairy-farms and market-gardens, so also is the city itself; and just as the abundant stable and other litter from a large city compels intensive cultivation and luxuriant crops in its immediate neighbourhood, so there are certain areas north-east and south-west of the city, and within carting distance, in which are grown magnificent crops of grain, potatoes, roots, and fodder. But the great metropolitan area outside these limits is a vast collecting-ground for the Irish cattle that are eventually sent across the Irish Channel. In modern times, more especially since the introduction of railways and steam-boats, the tendency of the agriculturist has been to specialize: to grow the crops most favoured by his soil, climate, and commercial position. Thus the east of England and Scotland has specialized in grain and roots, while the west, with its moister climate and uneven surface, has specialized in pasture and meadow. Thus, also, the east, compelled to convert its unmarketable straw and roots into something

else, turns to the west for young cattle and sheep to be converted into beef and mutton, while the west turns its unmarketable pasture into milk or its products, and, lacking roots and fodder to fatten its young stock, sends them eastwards to be fattened.

Ireland, under partly similar conditions, has fallen into the same productive groove as the west of England and Scotland, but with this difference that, while turnips and straw and the consumption of imported feeding-stuffs have been creeping gradually westwards in England and Scotland, and the number of young stock sent east to be fattened has been gradually diminishing, no such movement has taken place in Ireland. The result has been that, while eastern farmers have looked more and more to Ireland for their "stores," Ireland has set herself more and more to meet the demand.

The production of the Irish store-cattle begins in the west and in more uneven and less fertile land north and south of the central plain. There the calves are born and reared upon that part of the milk that is not turned into butter in the farmer's house or in the creamery. As yearlings they are sold to graziers in the creamery districts or in the less fertile parts of the central plain. As two-year-olds they move to the more fertile lands converging eastwards in the direction of Dublin, which is the centre from which they are exported to England.

Thus the bulk of the pasture of the great metropolitan area is grazed by two-year-old bullocks, drawn originally from the dairy-farming districts outside the central plain. The vast majority of these store-cattle are exported in autumn to the fattening centres in the east of England; but, with the assistance of cotton-cake and other feeding-stuffs, a certain proportion is fattened for some of the English markets. Some idea of the importance of the cattle industry in the Dublin district may be gathered from the fact that of the 841,973 cattle of all ages and kinds exported to Britain in 1907, 882,995 passed through Dublin port. Within the Dublin area, there are many pure-bred herds of Short-horn, Aberdeen-Angus, Hereford, and Kerry cattle. Since the advent of the Department of

Agriculture and Technical Instruction for Ireland, an impulse has been given to the breeding of pure-bred cattle and other stock. In connexion with their schemes for improving the stock of the country, high-class herds of pure-bred Short-horns and Yorkshire pigs are kept at the Albert Agricultural College, Glasnevin.

AGRICULTURE IN THE COUNTY OF DUBLIN.

By J. W. M'KAY, A.R.C.Sc.I.

The amount of tillage in this county is very much less than might be expected from its proximity to such a large consuming-centre as the city of Dublin. It is estimated that in round numbers there is an area of 200,000 acres available for tillage; of this only about 40,000 acres is cultivated; a further 80,000 acres is occupied by permanent meadow, and the remainder is devoted to pasture. For a distance of two or three miles beyond the city-boundary the cultivable land is mainly occupied by market-gardens and dairy-farms. A further distance of six to eight miles beyond this area includes the greater part of the tillage of the county. The soil here is naturally deep and strong, and, as large quantities of manure and refuse of various descriptions are easily obtainable from the city, it is in a high state of fertility, and the general style of farming is of a high class. Oats, potatoes, and wheat are the most important crops grown, giving yields equal to, if not greater than, those obtained in any other part of the country. A narrow strip of tilled land extends along the sea-coast for the length of the county, and, with this exception, practically the whole of the remainder is in pastured by two- and three-year-old cattle bought in western and southern fairs during March and April.

The dairying trade is a very important one in County Dublin; there are about 18,000 cows in the county, and many of these are in the hands of city dairymen, who grow little or none of the food used. Most of them have grazing farms in the immediate neighbourhood of the city, and to these the cattle are turned out during the summer. The pasture is of excellent quality, as it has been lavishly

manured time after time, so that little extra food is required to maintain the flow of milk during the summer. In the winter-time these cattle are fed in yards adjoining the owners' distributing-shops. The fodder and roots required are purchased in the market, and quantities of by-products from the breweries and distilleries of the city are used along with these. A common method adopted by dairymen is to contract with a farmer to supply litter, and remove the manure at a certain rate per cow, so that the farmer in a tillage-district keeps very little live stock, beyond the horses required for the working of his farm, tills practically the whole of his lands, sells off almost all the crops, and brings back manure from the city in the carts that have taken his produce to market.

The co-operative movement, which in many other parts of Ireland has exercised so beneficial an effect on the farming industry, never succeeded in gaining a footing in the metropolitan county; and probably in no part of Ireland are the people less inclined to unite in this way. The only attempt at co-operation is a small society established by the Rush farmers for the purchase of seed-potatoes for the early potato-growing industry.

Near Rush, Messrs. Hogg & Robertson have established a bulb-farm on soil formed of wind-blown sand, closely resembling that within the dunes of Holland; and the early potatoes above referred to are grown on the same quality of land.

AGRICULTURE IN THE COUNTY OF MEATH.

By NEIL LEITCH, B.Sc.

Meath lies to the north and north-west of County Dublin, and within easy reach of the city itself. Except at the extreme north-west end of the county, which is of an uneven surface, and a few heights such as Skryne, the famous old hills of Tara and Slane, and the hill of Ward above Athboy, the county may be described as flat. It is well watered by the rivers Boyne and Blackwater, the former draining the south, and the latter the northern and western areas. These rivers join at Navan, and flow together towards the sea at Drogheda.

On the whole, the county is well wooded and the climate is mild, though in the centre it is very depressing—a feature due, no doubt, to the level nature of the country, the prevalence of woods, and the amount of land under grass.

The soils vary greatly, from light gravelly land in the south of Trim to, in the northern portion, cold clay (boulder-clay). The central part, however, has soils of a good heavy loamy texture, lying on a limestone basis, and naturally adapted for grazing. Indeed, there is little soil in the county that could be described as poor.

Strangers coming by either railway to Meath, but especially by the Midland, are at once struck by the large tract of un-tilled land, and the comparatively small amount of tillage. Many causes may be put forward to account for this, but the greatest and most important of these is that the land is suitable for grazing.

There is no possible doubt that some of the finest grazing land in Ireland lies in Meath, though there is a good tract of land which is only moderate grazing-land at present which, if put under a proper system of tillage for a few years, would in the course of time, given suitable treatment, develop into sound grazing land. The best grazing districts are around Navan, Wilkinstown, Nobber, Carlans-town, Kells, Athboy, and from Trim, grading off towards the inferior lands in the south-eastern end. On the outskirts of the county the land is lighter and poorer, and more suitable for tillage. Little tillage is carried on, and what there is, is not of a very up-to-date standard. There is too much hand-labour, and too little horse-labour, to make it efficient and profitable.

The principal source from which the majority of farmers derive a living is cattle and cattle-grazing. The system on which cattle are grazed is known as "the eleven months." Where a farmer has a grass farm, he puts it, or part of it, into the auctioneer's hands, and it is then let for grazing cattle for eleven months. The cattle are bought in neighbouring counties, and put on to graze by the man who takes the land. During the early part of the year they receive a daily foddering of hay, in most cases during the months of February and March, when grass is at its worst

here. These cattle generally range from eighteen months to two or two and a half years, and occupy the land till October and November, when they are removed and sold by "private bargain" in the open fairs throughout the county, for exportation across the Channel, where they are house-fed. From some of the best grazing districts, early beef, and especially heifer-beef, is put on the market during the latter part of June and the first week of July, these cattle getting a little hand-feeding previously.

Very little cattle-raising is done, most of the store-cattle being, as stated above, purchased in the neighbouring counties.

As previously mentioned, little tillage is carried on, and this only on the outskirts. In the centre, small patches may be seen bordering on bogs, etc. The chief crops raised are oats, potatoes, turnips, and mangels, and first-crop hay. Unfortunately no definite system of tillage is carried on, many farmers having only one and the same field constantly under cultivation for years, without changing to another. This they do, they say, because it is more easily "laboured."

The difficulty of procuring efficient labour, the tall-growing open hedges wasting good grazing land for yards into the fields on either side, and the ditches in many cases not properly cleaned, are clearly consequences of the general grazing system.

Dairying is practically unknown. Co-operative dairy-societies do not exist. Stall-feeding is hardly thought of, and what cattle are stall-fed are as a rule those that could not be sold in the fairs. Feeding consists of turnips or mangels, bruised oats, and hay. No value for feeding is put on straw. It is no uncommon sight to see ricks of straw standing untouched in late spring as they were left in November at threshing time.

There are a few co-operative societies in the county, but they only exist for selling seeds and manure. Any products the farmers have are sold in the open market, and one great drawback to their receiving a good price is that they never think of grading their produce. If co-operative societies existed to which sales could be made, farmers would receive a sound education in this respect.

AGRICULTURE IN THE COUNTY OF KILDARE.

BY THOMAS WADE.

The main line from Dublin to Cork divides Kildare into two fairly equal sections which differ not only geographically but agriculturally. The northern portion is devoted chiefly to live-stock farming, being largely in grass, while the southern end is occupied chiefly by tillage. The traveller's attention is drawn to the wide, flat stretch of country that begins to open out as the county is entered. It marks the commencement of the central drift-covered plain. The soils in the northern portion are derived principally from the boulder-clays, and in the south from the limestone-gravels.

The size of the farms varies considerably, ranging from a few acres to holdings of 300 acres and over, a considerable number being of about 100 acres. Most of the land is now owned by the occupiers, having been purchased under the various Land Acts. The change in ownership has had a marked effect in improving the system of farming.

In the south of the county the land is farmed on a four-course rotation, varied in some cases by one of five or six years, by the leaving of the land in grass for more than one year.

Barley forms the staple crop in the tillage districts. The grain is generally plump and of good quality. It is converted into malt in Athy and neighbouring towns. The only other feature of importance in the tillage districts is the production of beef in winter by stall-feeding ; Kildare is the principal county in Ireland for stall-fed beef-cattle. Turnips and mangels are in consequence extensively grown. Crops of twenty-five tons and thirty-five tons respectively, on an average, are easy of production. Latterly the disease phoma has caused much loss amongst these crops locally. In the central portion of the county the growth of hay and of oats is of much importance, the Curragh, the headquarters of Irish racing and thoroughbred horse-breeding, being there situated. The limestone-gravel soils appear to be suited in an eminent degree for the production of horses of stamina and quality ; and recently some

notable English breeders have taken stud farms in Kildare. Clovers and other members of the Leguminosæ are often very conspicuous in the grass lands of better quality. The richest of these are devoted to summer-fattening of cattle. In sheltered and well-favoured places it is not uncommon for cattle that have been wintered outside on hay and grass to be fat by the end of May without the aid of cake- or hand-feeding. On such lands two lots of cattle are easily fattened during the summer. The herbage on much of these lands seems to tend towards fattening the ordinary Short-horn milch-cattle rather than to stimulating them to milk-production. At all events, dairying is not practised to any extent, the young cattle for the feeder and the grazier being purchased in the dairying counties of the south. The breeding of pure-bred stock is practised by a few. The county, in the Straffan herd, boasts two distinctions in this direction, i.e. the largest herd of pure-bred Short-horns in the British Isles ; and a breed—the Dexter Short-horn—which is a miniature Short-horn perfect in shape and symmetry, but combining the hardiness and milking qualities of the Dexter. At Carton, the seat of the Duke of Leinster, and at Ard Caien, Naas, there are herds of pure Kerries and Dexters.

After supplying fuel for centuries, there still remains a vast area of bog (the Bog of Allen). As the bog is used up and the turf-cutting bank recedes, the area cleared is enclosed. Levelling, draining, and years of spade-labour gradually reduce the vegetable débris to a degree of firmness. Crops of potatoes and rye are taken for a few years, and eventually, as the ground becomes firmer, horse-labour is introduced, and that amount of cultivable land may be said to have been added to the earth's surface. Hundreds of acres of this "cut-away" bog are now in cultivation and bearing useful crops.

The conditions of farming do not lend themselves to co-operation—at all events in its productive form. In other directions farmers are enterprising and up-to-date. The County Council and the County Agricultural Committee have set an example to all public bodies by establishing what are in essence the nucleus of public forests—in this

case County Council woods. The land, some 170 acres, in several divisions in different parts of the county, has been acquired either by free gift or purchase, and is either already under existing timber, or has been planted, under expert advice and management, with the most suitable and useful trees for timber purposes.

AGRICULTURE IN THE COUNTY OF WICKLOW.

BY A. NOLAN.

The county of Wicklow comprises an area of 500,178 acres, of which, in 1907, 85,968 were under farm-crops, 247,885 in pasture, 19,004 in plantations, 146,781 in waste bog, mountain, &c., and 1000 under water. The surface is much diversified and highly picturesque, rising in the interior into mountain groups, intersected by deep valleys; it declines to the sea on the east, and to the general level of the central plain on the west. In the arable portions of the mountain districts, the soil, which rests on granite, is shallow and light; and although not very fertile, with careful husbandry it produces moderate crops of oats, potatoes, and turnips. The higher hills are covered with heath and turf, and afford good pasturage for sheep. The soil on the declivities overlies slate, and varies in character from light clay for the greater part to heavy clay in a few small areas some distance from the seaboard; when properly treated, it affords excellent crops of all kinds. In some of the valleys approaching the sea, the soil is of an alluvial character and naturally fertile.

The climate in those parts of the county in which the best portions of the arable land are situated is mild and equable, and highly favourable to up-to-date agricultural pursuits.

Broadly speaking, the systems of farming pursued may be classified as follows:—

- I.—Dairying, stock-raising, and tillage.
- II.—Stock-raising and tillage.
- III.—Sheep-raising.

Systems I. and II. are followed in the valleys and on

the declivities, the former by men holding, say, 150 acres down, and the latter by those whose holdings exceed 150 acres. Farmers who adopt system II. stock their land with young cattle which they purchase in the local fairs, and which they in turn dispose of as fat beasts or forward stores. A large proportion of the milk produced on the farms adjacent to the railway between Newcastle and Arklow is disposed of in Dublin. The only creamery in the county is situated mid-way between Wicklow and Arklow; it is on a co-operative basis, and fairly successful; but it would be much more prosperous if it received a full supply of milk all the year round, instead of doing so only in summer as at present. Winter-dairying can hardly be said to exist in the county, except on a few isolated farms; and its absence is mainly due to the fact that farmers do not grow sufficient suitable foods, such as mangels and cabbage, for their cows in winter. Cream-separators have been introduced on a few farms during 1907.

Sheep-raising, extensively practised on the mountain-farms, has proved very profitable during the past few years. The variety of sheep kept is known to farmers throughout the country as the "Wicklow Mountain Breed." It was originally produced by crossing the sheep of the Wicklow hills with the Cheviot breed. It possesses the good qualities of the latter, which it surpasses in point of size and adaptability to the lands over which it ranges. These sheep are much sought after by graziers in other parts of the country on account of their hardiness, the excellence of their mutton, and their good nursing qualities. No fixed system of cropping is adopted. As a rule, one or two crops of oats are taken after grass (wheat and barley are very little grown), then a green crop, followed by oats, with clover and grass seeds, after which one or two crops of hay are taken; and the land is then grazed for three or more years, according to the size of the farm and the quality of the herbage it produces. Occasionally turnips and potatoes follow grass. Thanks to the teaching of the Department of Agriculture, and the great stimulus given by the Land Act of 1903, farmers are making commendable efforts to improve their holdings in every direction. More

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PLATE XXXVII.

[To face page 437.]



A FIELD OF TOBACCO AT RANDALSTOWN, CO. MEATH.

attention is now given to the preservation and application of farmyard manure, a larger and more judicious use is made of artificial fertilizers, tillage operations are performed in a more skilful and thorough manner, greater care is exercised in the selection of seeds, and potato-spraying is practised more or less extensively. The quality of the live-stock kept has been improved to a considerable extent in recent years.

There is no general system of agricultural co-operation in existence ; but an agricultural co-operative society has been recently established at Tinahely. There are three agricultural credit societies in the county, and these are doing good work.

TOBACCO-GROWING IN IRELAND.

By J. R. CAMPBELL, B.Sc.

Experiments in the growing of tobacco, under the supervision of the Department of Agriculture and Technical Instruction, have been in progress during the past eight years. In the first three years the experiments were, for the most part, conducted on small plots widely distributed ; and the curing of the leaf was conducted under great disadvantages. In the year 1904 it was decided to carry out experiments on a more extensive scale, in order that the commercial possibilities of the crop might be adequately tested. To effect this object, it was necessary that provision for curing the leaf should be made at each experimental centre, as well as for the planting of a considerable area with tobacco. In the year mentioned tobacco was grown on twenty acres. The number of centres and the area under tobacco have subsequently increased ; and during last year (1907) the experiments were carried on at eleven centres in seven counties, viz., Louth, Meath, King's County, Kilkenny, Wexford, Cork, and Limerick, the total area cropped being almost 100 acres. The work is being continued on the same scale during the current year.

The period for which the large-scale experiments were authorized was originally limited to five years. It has

been, however, extended to ten years, and will terminate in 1918.

So far, it has been demonstrated that the tobacco plant grows exceptionally well in several districts in Ireland on soils which are typical of large areas throughout the country. All classes of tobacco have been grown with a notable uniformity of success. The greater part of the area available has hitherto been cropped with the commoner classes of tobacco, as these varieties are produced most easily, and are suitable for trial by inexperienced growers. Several of the more skilful growers are, however, making plantations of the finer kinds of leaf.

The conditions under which tobacco is grown in Ireland have no exact counterpart in any country where the crop is already a staple; and the hasty adoption—without modification—of the practice of any foreign country could not but result in failure. Much work has already been done in adapting recognized methods to Irish conditions; and constant efforts are being made towards the simplification of the processes and the reduction of expenses.

Improvements in the methods of cultivating and curing are being rapidly introduced as the growers acquire more intimate knowledge of the requirements of the crop and increased skill in handling it. The work is, therefore, in a transition stage; and the results already obtained cannot be regarded as affording grounds for a final conclusion as to the average cost of production or the net return to the grower.

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